THE SOCIAL DIMENSION OF STORMWATER MANAGEMENT PRACTICES INCLUDING SUSTAINABLE URBAN DRAINAGE SYSTEMS AND RIVER MANAGEMENT OPTIONS

BY

STELLA APOSTOLAKI BSc, MSc

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I certify that this thesis is the true and accurate version of the thesis approved by the examiners

Signed.. [redacted] .. Date.. 15th February 2007

(Director of Studies)

UNIVERSITY of ABERTAY DUNDEE

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EXECUTIVE SUMMARY

The research programme was relevant to urban planning and in particular to the design of stormwater management schemes that are more environmentally and socially acceptable. It examined social and perception issues relating to stormwater management techniques within residential areas, and in particular to the application of SUDS, mainly ponds, and river management schemes.

The thesis arose from a project funded by the Environment Agency of England and Wales through SNIFFER under a programme titled *"Social impacts of stormwater management techniques including river management and SUDS"*, SNIFFER Code: SUDS01.

The public perception of construction is becoming a matter of increasing importance both in the UK and internationally since socio-economic parameters and public consultation both have to be taken into consideration in the planning and implementation of relevant projects. This research programme endeavoured to match the relevant legislative goals with society's actual needs.

The main aims of the research programme were to obtain an in-depth understanding and knowledge of the perceptions of popular stormwater management practices (SUDS and river management), and to evaluate these techniques from a social perspective. To satisfy these aims the following objectives were set:

- To assess public awareness and perceptions of SUDS (particularly retention ponds) in the UK;
- To assess professional perceptions of SUDS in the UK;
- To assess perceptions of different stormwater management techniques, in three European cities;
- To compare perceptions of different stormwater management techniques, SUDS and river management practices;
- To link the research findings with trends in perceptions of nature and water.

To meet the programme's aims and to satisfy the objectives, the perceptions of SUDS in the UK (principally ponds) were investigated over a wide range of locations. In addition, the

different river management approaches used in three heavily urbanised European cities, Glasgow, London, and Athens were investigated.

The results of this research programme provide a means to understand perceptions of stormwater management and to appreciate what types of schemes will be more readily accepted by the public.

The research has shown that members of the public hold strong views as to what they like or dislike about SUDS and water management installations in their local area, in spite of the fact that there were demonstrably low levels of public awareness of SUDS. The amenity, recreational value and aesthetics of new schemes seem to be of major importance for public acceptability, while function, efficiency, and maintenance are primarily important in areas facing flooding problems. Other key findings include the fact that there is a general preference for sustainable urban water management and for river restoration schemes compared with more conventional, 'hard engineering' approaches, such as culverting of rivers. This preference was expressed both by members of the public and by professionals involved in their planning and implementation.

Another important result was that although unfamiliarity can produce negativity, education can influence attitudes positively even in sensitive issues such as safety, and can be used by authorities and planners as a means of enhancing the acceptability of new schemes. Consequently, the results of the surveys can be used as arguments towards the application of informative campaigns which should be taken into account prior to scheme implementation. This information can be utilised not only for stormwater management design, but also for other environmentally friendly constructions which the public may have a low level of awareness.

Recommendations are made with respect to public and professional attitudes for improving the public acceptability of new and modified stormwater management systems. Recommendations and barriers to the uptake outlined in this thesis mainly refer to the appearance of schemes rather than technical issues. They are therefore of most use as guidance for improving aesthetics and increasing public acceptability.

The outcomes of this research will be of use to policy makers, water companies, local authorities, environment agencies, planners, developers, consultants active in urban development, and researchers in applying wider-accepted practices for the assessment of public perception.

Some findings from this research have been presented at several stakeholders' meetings, at 4 conferences, and are published in the form of papers and reports, including the DTI SR 622 report titled "An Assessment of the Social Impacts of Sustainable Drainage Systems in the UK", and the Environment Agency & SNIFFER report, SUDS01, 2005, titled "Social Impacts of stormwater management techniques including river management and SUDS". This publication also constitutes Environment Agency R&D Technical report P2-258.

Key words: stormwater management, SUDS, river management, public perception, public involvement, urban planning, community engagement, community planning, green space, open space.

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1 INTRODUCTION

1.1 SCOPE OF THE RESEARCH

"When you start your journey to Ithaca you should wish the road to be long, full of adventure, full of knowledge..."

— Kavafis, 1911

Heavily urbanised areas often face severe flooding incidents due to increased urbanisation and lack of permeable surfaces. A range of stormwater management practices are used in urban areas depending on several factors such as the presence or lack of open and green spaces, the geomorphology of the area, and the perceptions of professionals and the public as to what forms the most appropriate stormwater management practice for the area under consideration. The areas of consideration for this research programme are currently served by traditional drainage systems, while Sustainable Urban Drainage Systems (SUDS) and rivers are used in some of the sites for the conveyance of rainwater.

The term SUDS refers to subsurface and above surface drainage constructions, which are considered to be sustainable, and are aimed at:

- Introducing treatment of runoff that is cost and energy efficient;
- Providing flow attenuation and protection from flooding;
- Improving amenity value;
- Introducing or enhancing the benefits of habitat biodiversity within stormwater management techniques.

Sustainable stormwater management techniques, as a component of sustainable construction, are gaining ground within current planning approaches. Unlike conventional drainage, SUDS are likely to form part of widely used public open spaces. This can promote positive interaction between communities and their local environment, and lead to environmental and amenity benefits. It follows that it is valid to try and link this type of sustainable system not only to the need for innovative drainage solutions, but also to the need for creating green open spaces,

resembling natural features, and enhancing the ecological potential of stream systems in urban environments (Jefferies and Barrett, 2002).

Stormwater management is becoming increasingly important in urban areas due to frequent flooding incidents in cities and the increased need for runoff collection and treatment. River management techniques, in combination with the use of SUDS provide appropriate solutions for heavily urbanised areas. Unfortunately, the social impacts of stormwater management technologies have been often ignored. Unless the needs of the local parties affected are taken into account, national policy objectives of developing better, greener cities and of achieving improved social justice will not be met.

SUDS are examples of a sustainable technology, which is applicable within urban areas as they have the potential to provide a series of benefits for the community. One objective of storm water management is the reduction of the flood hazard associated with large storm events by reducing the peak flow associated with these storms (Young et.al, 1996). In addition SUDS provide a more sustainable way of draining surface water, with special emphasis on amenity, biodiversity and social benefits. They were conceived, designed and constructed for urban runoff treatment in the U.S.A, where they are known by the term Best Management Practices (BMPs) (Urbonas & Stahre 1993, USEPA 1995). Recently they have been introduced to other countries facing similar problems with water runoff, such as Sweden, Japan, Britain, Switzerland, Germany, France, Australia, and South Africa. In Scotland, SUDS are now widely adopted for runoff collection and treatment and their use is now extending to other areas of the UK (Campbell, 2000; Krejci et al).

In contrast, river management techniques have been used since ancient times to deal with excess runoff. The latest trend in river management is river restoration, which is gaining ground to avoid culverting rivers which was a common practice up until the 1980s. This new tendency has resulted in the restoration and rehabilitation of many previously culverted rivers which are now more to natural in their appearance and functionality.

The acceptability of new stormwater management techniques by stakeholders and the public is still debatable and depends on many parameters such as:

- The technical characteristics of the schemes: function, efficiency, maintenance;
- Ecological and biological factors: environmental benefits, creation of new habitats;

- Economic factors: construction & maintenance costs, the cost of new management approaches versus traditional stormwater practices;
- Amenity issues: creation of amenity areas;
- Social concerns.

This research is set against a backdrop of efforts in the UK to provide open green spaces within new and existing developments, both at a national and local scale. This drive is associated with government aspirations to create sustainable communities and to secure environmental justice, in which all citizens have the right to a high quality of life and access to good quality environments. In an ideal society, social equity and justice is taken into account during the planning process. The well-being of urban citizens is considered in this process and the final implementation of a project provides equal access to resources and benefits for all (Liu, 2001). Unfortunately, most frequently, those who have to live in the least sustainable 'undesirable' environments, in marginal areas of cities with least access to green spaces or at risk from floods, are the poorest citizens or those who cannot afford to relocate even when they wish to (UNESCO, 2003).

The main aims of this research programme were to investigate public and professional perceptions of Sustainable Urban Drainage Systems (SUDS) and of different river management practices, and to make recommendations on how to enhance acceptability of such schemes within urban areas. The outcomes presented are multidisciplinary, and straddle the sectors of engineering and social science. Environmental theories related to perceptions of nature and water bodies, and their impact on formulating attitudes towards environmental issues and towards influencing contemporary environmental thinking are also examined, as well as the emergence of the idea of sustainability.

This research project made use of previous experience on the public perception of SUDS in Scotland (Apostolaki et al., 2001) which formed part of a Master's thesis. Due to its novelty in SUDS related research, this work, when presented at the 1st International Conference on SUDS (Coventry, June 2001) attracted the interest of the audience, and in particular of HR Wallingford and the Environment Agency of England and Wales, in extending the research on social impacts of stormwater management techniques, and in providing the incentive for the funding and completing a PhD programme.

The PhD programme was funded by the Environment Agency of England and Wales through the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) under a programme titled "Social impacts of stormwater management techniques including river management and SUDS", SNIFFER Code: SUDS01. HR Wallingford also supported the project as the work formed the 'social impacts' component of the DTI PII Project "Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits".

An important incentive for completing this research programme was the interest expressed by the funding institutions, in determining the public perception of SUDS and river management approaches, and in evaluating these stormwater management practices, from a social perspective.

Developers and consultants also have an interest in the social aspects of SUDS due to the requirements of the public bodies responsible for strategic stormwater management plans – the Water Authorities, the Environment Agency of England and Wales, and the Scottish Environment Protection Agency -SEPA. The adoption of SUDS requires joint action by several groups of individuals and organisations including Local Authorities (Parks Departments and Highways Authorities), Water Authorities; Developers; and the Regulator - Environment Agency of England and Wales and SEPA. This need for joint action also formed a principal incentive for this research programme.

The research programme investigated perceptions of SUDS in a number of regions within the UK and of different river management techniques in three heavily urbanised European cities, Glasgow, London, and Athens. The programme was divided into three main phases:

- Assessment of public perception of SUDS in the U.K.;
- Assessment of professional perception of SUDS in the U.K.;
- Assessment of public & professional perception of three different stormwater management practices in Glasgow, London, and Athens.

The comparative nature of the assessments carried out during the three research phases relied on the fact that all these phases all served the common aim of assessing attitudes on stormwater management options, and made use of similar investigative methods. Consequently, the results of these assessments were interlinked to provide a holistic view of the perceptions and attitudes towards open water schemes implemented in residential areas. One of the important outcomes

of the research is the formation of common recommendations on how to improve performance and acceptability of the stormwater management schemes investigated. This knowledge can eventually be used to provide suggestions for improvements in the design and the applicability of stormwater management practices, in order to enhance public acceptability.

The results of the research presented are of interest to local authorities, environment agencies, planners and researchers who wish to apply and understand widely accepted practices for the assessment of public perception. The public perception of construction is becoming of increasing importance both in the UK and internationally since socio-economic factors as well as public consultation now have to be considered in the planning and implementation of all relevant projects. This research programme matches relevant legislative goals with society's actual needs.

The current research on the public perception of SUDS, formed the 'social impacts' component of the DTI PII Project *"Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits"*. This was the first attempt to investigate and assess public attitudes to SUDS in the UK. Both previous and parallel attempts to assess perceptions concentrated on professionals and stakeholders involved in SUDS. Due to the originality of the research the current programme was positively received by water authorities and this was the main reason that it attracted the interest of the Environment of England and Wales.

The research on professional/expert perception of SUDS, as part of this project, is also complementary to research undertaken by Hyder Consulting Ltd (HCL) on behalf of SEPA, on the evaluation of SUDS guidance in the UK (Wild et al, 2003). The conclusions of this study were similar to those of the present study; i.e., the level of awareness strongly influences stakeholders' views as to the advantages of SUDS with respect to amenity, biodiversity, and safety, while the most frequently cited perceived deterrent to the use of SUDS was 'responsibility for adoption and maintenance'. In addition, the CIRIA SUDS Design Manual (CIRIA, 2000) appears to be used widely by SUDS stakeholders. Other pieces of research on stakeholders' perception on SUDS carried out in the UK reached similar conclusions regarding barriers to SUDS implementation and reluctance to their use; the main deterrents to the use of SUDS being the lack of relevant information / training amongst developers, policy gaps for SUDS adoption, the lack of guidance and expertise in SUDS design, and the adoption of maintenance (M^{c}Kissock et. al., 1999; Howe & White, 2002).

Apart from the obvious interest in comparing attitudes to different stormwater management practices in a number of countries and regulatory regimes, which gives an international dimension to this research programme, there is one further reason for undertaking a comparative study, and in particular for comparing different practices in the two capital cities of London and Athens. The Athens case study provides an example where the potential for serious flooding increased due to the pressure of the 2004 Olympic Games, and the need for flood protection of the city has been undermined by the city authorities. Priority was given to the construction of new roadworks, which 'solved' chronic traffic problems in the city (TEE, 2002a; Appendix III-A). This resulted in the culverting of the Kifisos River to construct a new motorway, despite the fact that this is expected to cause severe flooding problems in the future and the new highway damages the surrounding area. The research programme investigated the opinions and beliefs of those who will be most affected by the river works. The Kifisos River example compares well with a flood attenuation scheme in a local park in Brent, London. It is also particularly apposite in view of London being nominated as the 2012 Olympic City where most of the venues will be in the Lea Valley – where flooding issues have been a major concern for many years.

1.2 AIMS & OBJECTIVES OF THE RESEARCH

This research programme was built around one central aim, which is satisfied through a series of objectives as outlined below:

Aim

To obtain an in-depth understanding and knowledge of the perceptions of popular stormwater management practices, SUDS and river management, and to investigate how these perceptions are influenced by social conditions and contemporary thinking.

Objectives to satisfy the project Aim

- To assess public awareness and perceptions of SUDS (particularly retention ponds) in the UK;
- To assess professional perceptions of SUDS in the UK;

- To assess perceptions of different stormwater management techniques in three European cities;
- To make recommendations on how to improve SUDS and rivers and how to enhance public participation in planning of SUDS/river management options;
- To compare perceptions of different stormwater management techniques, SUDS and river management practices;
- To link the research findings with trends in perceptions of nature and water.

The objective related to the assessment of perceptions corresponds to the first research phase of the PhD programme. The assessment of public perception of SUDS in the U.K. (2001-2002) extended the work previously carried out on public attitudes in Scotland, and provided a more comprehensive view of what people think about these systems. The public perception surveys made use of quantitative investigative methods, and looked into the social acceptability of SUDS in the U.K. At the same time this piece of research tried to place SUDS within the context of application of sustainable practices in urban environments. The detailed results, which were the basis of a paper presented at the Fifth Symposium of the International Urban Planning and Environmental Association on Creating Sustainable Urban Environments: Future Forms for City Living, Christ Church, Oxford, September 2002, are included in Chapter 3 of the Thesis. The results of this research phase also formed the social component of the HR Wallingford Report SR 622 (2003), DTI PII Project *'Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits'*.

Results from the assessment of professional perceptions of SUDS (2002-2003), which utilised qualitative research methods, highlighted the similarities and differences between public and professional perceptions of SUDS in the U.K. The detailed results from this research phase are included in Chapter 4, and were presented to a wider audience at the First International Conference on 'Sustainable Development and Management of the Subsurface', Utrecht, Netherlands, 5-7 November 2003.

The third research phase (2003-2004), refers to the comparative study between Glasgow, London, and Athens, and makes use of a triangulation of methods which are explained in detail in Chapter 3 and combines quantitative and qualitative methods depending on the requirements of the project.

This research phase combined findings of the social impacts of the application of SUDS and river management practices in the U.K. and Greece. The results of all three research phases were included and presented in a paper at the 10th International Conference on Urban Drainage, Copenhagen/Denmark, 21-26 August 2005.

A combination and comparison of the results from all research phases are presented in detail in the discussion and conclusion Chapters of the Thesis, while a report titled *'Social Impacts of Stormwater management techniques including river management and SUDS'* was produced in 2005 for the Environment Agency & SNIFFER.

All these interactions between objectives, methodologies to satisfy the objectives, and research outcomes, either in the form of achievements or as reporting/dissemination outcomes are presented schematically in Figure 1-1.

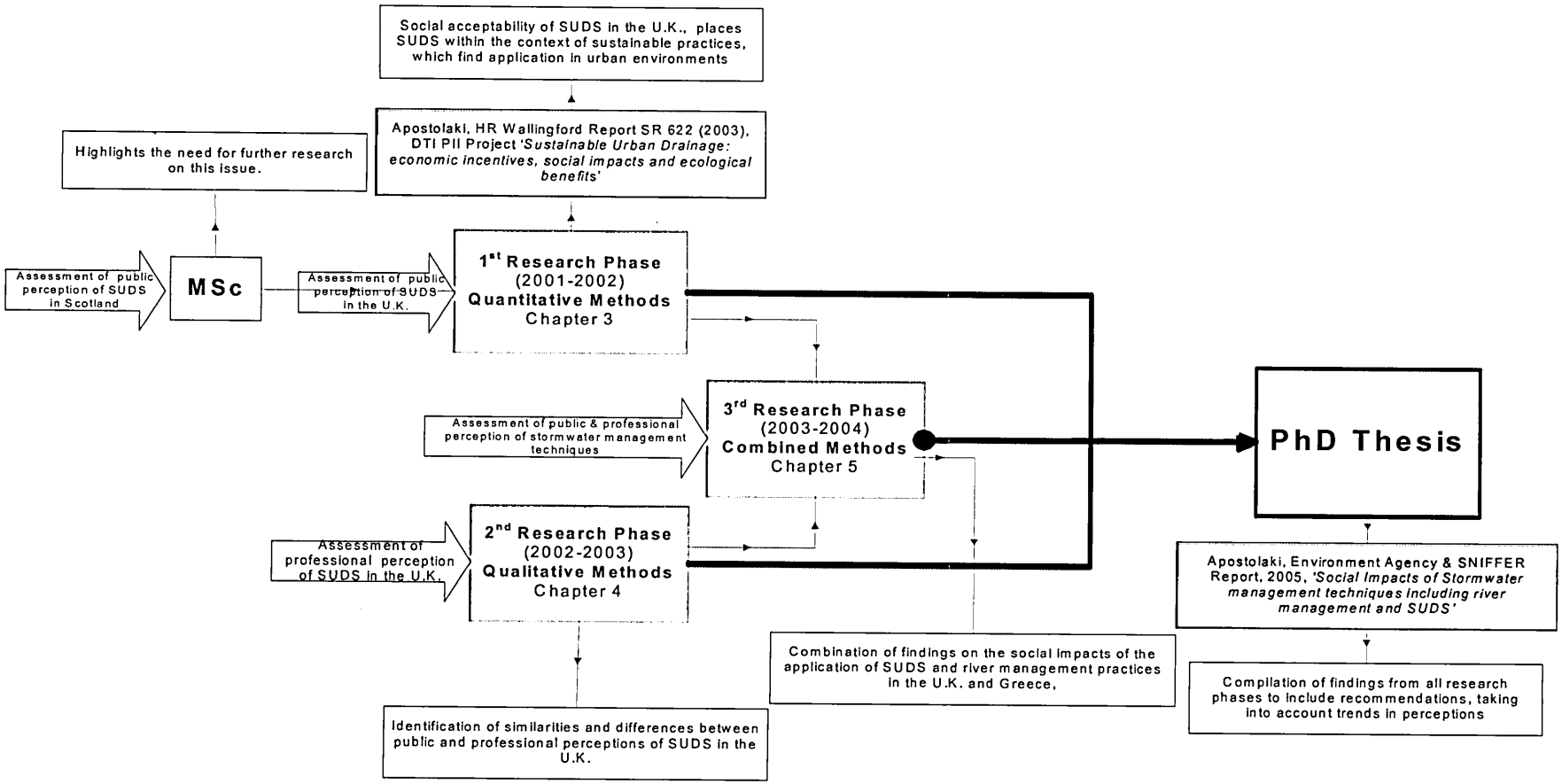

Figure 1-1 Schematic representation of objectives, research phases, chapters and publications of the PhD thesis

1.3 SELECTION OF METHODOLOGY & RESEARCH PHASES

Sociological investigative methods were used to address the aims and objectives of the research programme. In similar types of research, which have taken place before or in parallel to the current research work, engagement of sociological methods is thought to be the most appropriate means of assessing attitudes to new architectural schemes and practices. In the U.K. relevant research has focused on assessment of stakeholder attitudes to SUDS, and the use of qualitative methods using personal interviews and focus groups is common practice. However, quantitative methods in the form of questionnaires, either postal or addressed personally were also used to a lesser extent (M^{c}Kissock et. al., 1999; Wild et al., 2003; Howe & White, 2002).

It is worth mentioning here that no examples of the assessment of public perceptions of SUDS undertaken by other researchers in the UK were found, and only one relevant example was identified at European level, in Sweden (Hjerpe & Krantz, 2000). The public perception of SUDS was previously assessed in Scotland as part of the MSc thesis that formed the impetus for this research programme. The methods engaged in these two cases, as well as the methodology from other perception surveys of water-related issues (Souter et al., 1998; Ashley et al., 1999) are a combination of quantitative and qualitative investigative methods (Apostolaki, 2001; Hjerpe & Krantz, 2000).

The public perception surveys of water related issues often use sociological method since these are deemed the most direct ways of gathering attitudes and ideas for increasing acceptability. Such pieces of research can make use of visual and acoustic means to gather spontaneous responses from the participants (Yamashita, 2002; Musacchio & Coulson, 2001), or simply by making use of questionnaires (River Brent Enhancement Project, 1999). The methods used for the assessment of public perceptions of the River Brent (1999) prior to the implementation of the river enhancement project, are of particular interest to the research project currently presented and played an important role in formulating the methodology used. The River Brent Park is one of the sites chosen for the comparative study of this research project.

Similar investigative methods were used to assess perceptions in the different research phases, so as to allow for comparison between the study areas and the stages. The project made use of both quantitative and qualitative methods depending on the needs of each research phase. Door-to-door interviewer-administered questionnaires with open-ended questions were used to

assess public perception of SUDS in the U.K. and of the stormwater management practices in Glasgow and London. Semi-structured interviews and focus groups were used to assess professional perceptions as well as public attitudes in sensitive areas, as in the case of Athens. Door-to-door surveying was not used in Athens to avoid biasing responses and raising public concerns above the high levels which already existed; the works at Kifisos were a very sensitive issue for the local residents and the policy makers giving rise to a series of public protests.

First research phase – Public perception of SUDS in the U.K.

The first phase of the research, was undertaken in 2001-2002 and focused on assessing public perceptions of SUDS throughout the UK using door-to-door questionnaires. This work was carried out as part of the 'social impacts' component of the HR Wallingford Report SR 622 on the DTI PII Project 'Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits', included as *"An assessment of the Social Impacts of Sustainable Drainage in the U.K."*.

Second research phase – Professional perception of SUDS in the U.K.

To obtain a more holistic view on perceptions of SUDS, professional opinions on SUDS were investigated during the second research phase, 2002-2003. The survey was based on a series of interviews and focus groups with developers, planners, design engineers, academics, landscape architects, environment protection officers, water authorities, and local authorities. Interpretation of the combined results from the assessment of public and professional perception of SUDS was used to draw up recommendations on SUDS design and implementation that could assist in enhancing acceptability of SUDS within urban environments.

Third research phase – Comparative study

The comparative study of stormwater management issues in Glasgow, London, and Athens took place during the third research phase, 2003-2004. A combination of quantitative and qualitative investigate methods was used, based on experience gained during the two previous research phases. The sites selected were located within flood-prone urban areas, and the stormwater management plans suggested or implemented in all three cases involved river management. In the Glasgow example, it was suggested that a combined stormwater management approach could be implemented including river restoration and retrofit SUDS. In the London site, the first phase of a river restoration plan had already been completed at the

time of commencement of the research programme. In Athens, river culverting was underway and has now been completed. Although the London and Athens cases clearly refer to river management, completely different approaches have been followed, underlining the need for comparing the efficiency and the public acceptability of these two approaches. Detailed information on each site is presented in Chapter 6.

This comparative study between two countries, the UK and Greece, in areas facing similar stormwater management problems, provided a broadly based view of public attitudes at an international level. The results of the research have been used as the basis for forming recommendations on how to involve communities in urban water planning and on how to enhance public acceptability of new water-related schemes within established residential areas.

The methodology engaged enables both quantitative and qualitative information gathering that provides an insight into perceptions of stormwater management practices. The high numbers of questionnaires completed as part of the public perception surveys, provided a plethora of data. The research can be characterised as novel due to the fact that this was the first ever attempt to assess SUDS perceptions in the U.K. In addition, the number of questionnaires applied to SUDS and stormwater management practices (820) and the number of personal interviews (85 in total) undertaken as part of this research programme exceed those of previous or parallel attempts to assess perceptions of SUDS.

A triangulation of investigative methods was selected to give a comprehensive view of perceptions. Quantitative results indicate the current trends in thinking, and qualitative results underline the issues of major importance. The threads of thinking and the interrelated issues, affect perceptions and influence public acceptability. Details on the methodols followed in the different research phases are presented in the methodology Chapter.

1.4 ADVANCEMENT OF KNOWLEDGE

The research was multi-disciplinary, moving within the disciplines of engineering and social sciences. It was aimed at establishing linkages between engineering construction and management of flooding and its implications to society and the individuals and groups affected. Additionally, it has established linkages between philosophical and sociological ideas related to the environment and perceptions of nature and water in the context of newly constructed stormwater management components such as SUDS and river management

solutions. These practices are seen under the prism of urban landscape ideas, amenity, and recreation and not strictly from an engineering perspective in past cases.

Interest has been expressed by the institutions involved (Environment Agency of England and Wales, HR Wallingford) in developing and analysing a series of ideas concerning SUDS and to other stormwater management practices. Those ideas include:

- Awareness of the systems;
- Perceptions of the schemes and suggestions for improvement;
- Amenity/Recreation;
- Biodiversity;
- Safety;
- Sustainability of the schemes in comparison with engagement in other sustainable practices.

Analysis of these issues is considered useful for stakeholders involved in promoting the creation of inclusive and multifunctional green spaces which meet local needs and which are acceptable to the public and ensure social and environmental justice through providing services to the public aimed at improving everyday life. Previous relevant research mainly focuses on technical and construction issues, and do not take into account the social dimension of stormwater management, for example the importance of enhancing amenity, biodiversity and recreation issues. They also omit to investigate benefits to society and social acceptability. As a result, previous studies focused on stakeholder/professional perceptions rather than on the assessment of public needs. This knowledge of public attitudes, in combination with the willingness of professionals to accept new ideas which go hand-in-hand with public demand, can be a useful tool for public authorities in developing and implementing policies and practices which incorporate sustainability.

The publications which have arisen from this research programme can also be considered as a way of advancing knowledge and providing information on assessing perceptions of stormwater management techniques to a wider audience. These publications include the knowledge obtained through this research programme regarding matters of public and professional perceptions and acceptability of open-water stormwater management schemes,

and ways to influence perceptions towards adopting these practices. The publications, either in the form of papers presented at conferences or as reports emerging as a result of this research programme, attracted the interest of the audiences/readers due to the novelty of the subject (public perception of stormwater management practices is an issue not widely researched and as a thematic area is not covered in literature). The publications are presented below in chronological order[1].

1. Apostolaki S., Jefferies C., Souter N., 2001, *"Assessing the public perception of SUDS at two locations in Eastern Scotland"*, Proceedings of the First National Conference on SUDS, Coventry University.[2]

   The paper assessed attitudes of SUDS in Scotland and highlighted the need for further research on this issue.

2. Apostolaki S., Jefferies C., Smith M. & Woods-Ballard B., 2002, *"Social acceptability of Sustainable Urban Drainage Systems"*, Proceedings of the Fifth Symposium of the International Urban Planning and Environmental Association on Creating Sustainable Urban Environments: Future Forms for City Living, Christ Church, Oxford.

   The paper presented the social acceptability of SUDS in the U.K. and placed SUDS within the context of sustainable practices applied in urban environments.

3. Apostolaki S., Jefferies C., Smith M. & Chatfield P, 2003, *"Perception and social acceptability of sustainable urban drainage systems"* Proceedings of the First International Conference on 'Sustainable Development and Management of the Subsurface', Utrecht, Netherlands, 5-7 November 2003.

   This paper presented perceptions of SUDS in the U.K. and identified similarities and differences between public and professional perceptions. It also presented the relevant issues to an international audience and highlighted the importance of stormwater management for the management of the subsurface.

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[1] Abstracts of all papers are attached in Appendix IV

[2] Although this publication was based on results obtained from research undertaken as part of an MSc project by the author, it is included because of its importance in attracting the interest of HR Wallingford and the Environment Agency of England and Wales in extending the research on social impacts of stormwater management techniques, and in providing the incentive for the funding and the realisation of the PhD programme.

4. Apostolaki S., Jefferies C., HR Wallingford, 2003, Report SR 622 – *"An assessment of the Social Impacts of Sustainable Drainage in the U.K."*, DTI PII Project on 'Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits'. [3]

   The report presented the results of the first year of research on public perception of SUDS in the U.K.

5. Apostolaki S., Jefferies C., Environment Agency & SNIFFER, 2005, SUDS01, *"Social Impacts of stormwater management techniques including river management and SUDS"*. This publication also constitutes Environment Agency R&D Technical report P2-258. [4]

   The report presented the results of the three years of research on stormwater management techniques.

6. Apostolaki S., Jefferies C. & Wild T., 2005, *"The social impacts of stormwater management techniques"*, Proceedings of the 10th International Conference on Urban Drainage, Copenhagen/Denmark, 21-26 August 2005.

   This paper presented the social impacts of the application of SUDS and river management practices in the U.K. and Greece to an international audience, and highlighted the importance of public participation in decision making.

7. Apostolaki. S. Jefferies. C. & Wild.T., 2006, *"The social impacts of stormwater management techniques"*, Water Practice & Technology, Volume 1, issue 1, August 2006, Urban Drainage 10: Selected proceedings of the 10th International Congress on Urban Drainage, 21-26 August 2005, held in Copenhagen, Denmark

1.5 THESIS OUTLINE

The current thesis is divided into eight chapters. Chapter 1 is an introduction to the scope of the research, a presentation of the research aims & objectives, an outline of the methodology used

[3] http://www.hrwallingford.co.uk/publications/drainage.html#suds

[4] http://www.sniffer.org.uk

to serve the project aims, and reference to the contribution of the current research to the advancement of knowledge.

Chapter 2 is the literature review of the main issues related to the research work. The main issues identified in literature and related to perceptions and acceptability of SUDS and river management options are analysed thematically. This type of analysis for presentation and interpretation of research results is maintained throughout the whole thesis. The main themes identified as important for the current research work are related to environmental awareness, amenity, biodiversity, sustainability, urban landscape ideology and preferences, perceptions of water and safety, public participation and education.

An outline of the methodologies used is presented in Chapter 3. In this chapter there is particular reference to the methodologies selected and these are supported by the literature. There is also justification of the choice of quantitative and qualitative methodologies for assessing attitudes at the different research phases, and of the triangulation of methods.

This research project is divided into three phases, during which a combination of methodological approaches was used. Chapters 4, 5, and 6 present the research results, each one corresponding to one research phase. Chapter 4 refers to the assessment of public perception of SUDS in the U.K. Chapter 5 presents results on the assessment of professional perception of SUDS in the U.K. Chapter 6 is linked to the third research phase, which encompasses the comparative study of different stormwater management techniques in Glasgow, London, and Athens. These three chapters include an introduction to the relevant research phase with study details, background information of the study undertaken and site descriptions, aimed at clarifying all issues relevant to that phase. There is also a section dedicated to the results, and a discussion. However, Chapter 6 is divided into three parts, each referring separately to one of the study areas and following the same format, including site background information and a presentation of the flooding issues in the area, a description of results and discussion. Overall, Chapter 6 also follows the same structure as Chapters 4 & 5, and includes an introduction to the scope and characteristics of the comparative study, presentation of the relevant research issues in the three areas where the comparative study was applied, and the results of this research phase. An overall discussion section is also included, combining results from all three areas of application, and conclusions derived from the combination of outcomes.

Chapter 7 is the discussion chapter, in which there is a critical evaluation of the work undertaken during the research, a presentation of the research results with reference to the relevant literature, and the barriers to the design and application of stormwater management practices, as formed through the current work. There is also an attempt to link the current results with the theoretical approaches presented in the literature review chapter (Chapter 2).

Finally, Chapter 8 presents the conclusions of this research, namely recommendations for technical improvements to the examined stormwater management schemes regarding social acceptability, the advancement of knowledge from this research work, the application of the research and the limitations faced, as well as possibilities for continuation of the work.

1.6 PRINCIPAL OUTCOMES

1.6.1 General Outcomes

The environmental concerns expressed by participants who took part in all the surveys focussed mainly on global issues. Low levels of awareness about the local watercourse were identified despite the concerns over potential flooding and operation of local drainage systems.

One of the main outcomes of the research is related to the aesthetics of the stormwater management systems. People tend to be more positive towards schemes which are aesthetically pleasing and high aesthetic ratings are usually synonymous in people's minds with their natural appearance. Aesthetics seem to be one of the major advantages of stormwater management systems incorporating SUDS according to public attitudes and the perception of professionals, and tend to influence public opinion even when issues as important as safety are involved. The participants were less concerned over safety when aesthetically pleasing schemes of high recreational value were implemented. On the contrary, if the stormwater management schemes are of low aesthetic value and look untidy, people tend to think of them as unsafe and to be functioning badly. It seems that urban residents have such a high psychological need for contact with nature that they welcome green open spaces even when there are open water bodies. Other operational issues, such as their flood abatement, water treatment and safety functions, seem to play a less important role in formulating public opinion.

The improvement of amenity was perceived to be among the main advantages of ponds and of the river restoration schemes planned or completed. To most people, enhanced amenity means

the increase in recreational facilities, sport facilities, and the opportunity to use the open green space around ponds or close to rivers as leisure areas. Ecological benefits, which are also generally included in the term amenity, are highly appreciated; wildlife and plantlife are very much welcomed by local communities and are considered by many as educational resources for children.

Despite the safety concerns, which were identified among the main disadvantages of stormwater management systems, the vast majority of the participants still preferred to live in areas with open water schemes. In comparison to different safety risks present within residential areas, SUDS ponds and open rivers were classified as the least dangerous amongst the risks compared, and equally dangerous to natural ponds or rivers.

In addition, the sustainability of the stormwater management systems was assessed. When compared to other environmental friendly and sustainable practices, the stormwater management plans examined were classified as equally beneficial in most cases. However, the results, were highly dependent on how near completion were the stormwater management systems within the area. Several improvements/recommendations were also outlined by the public and professionals on how to improve functionality and acceptability of new stormwater management systems. These recommendations were also aimed at increasing the sustainability of the schemes through establishing a balance between environmental and social benefits, and economic efficiency in the construction and maintenance of the schemes.

All surveys carried out during the research programme indicated that there is a gap in information provided to the public, especially in matters regarding the adoption of stormwater management practices, the purpose served by the systems, their efficiency, and their benefits. This lack of information is considered to be one of the main factors generating negativity towards systems. Information and the aesthetics of a scheme are of major importance in influencing acceptability of new or innovative practices within residential areas.

Public consultation prior to construction and public participation in the planning and implementation process were shown to increase the acceptability of schemes. In areas where the public had been consulted prior to the implementation of the stormwater management scheme, the overall attitudes expressed were positive. In areas where the public felt that their ideas and needs were largely ignored, there was great disappointment, which in some cases is even likely to have a political cost (i.e. the case of Athens).

1.6.2 Recommendations and Barriers

As an outcome of the research it is recommended that works should be made attractive. In general, people consider a scheme to be aesthetically pleasing when it resembles a natural watercourse as much as possible. Soft engineering practices, incorporating shallow slopes, shallow water and marginal pond vegetation, are recommended.

Landscaping can either be a motive or a deterrent to the application of above ground stormwater management schemes; in most situations landscaping is not undertaken by landscape architects, resulting in the construction of systems of low aesthetic value.

Many householders proposed the introduction of signs around a pond or close to riverbanks warning of deep water. On the other hand, the introduction of warning signs was thought to have a major drawback since they attract attention and underline the fact that the watercourses present are man-made, which makes people more suspicious. People tend to perceive natural watercourses to be nice and safe or at least to be necessary, but they often question the relevance of man-made structures.

The introduction of native vegetation was recommended by many participants. Professionals referred to the fact that native plant species become established very quickly and are almost self-maintaining. At the same time they attract various species of wildlife already present in the area and form natural habitats or even shelterbelts. The presence of wildlife and rich plant life in open water schemes can be a crucial factor in ensuring a positive public opinion.

The transformation of stormwater management schemes into amenity features, the introduction of benches and picnic tables overlooking the open water, the creation of children's playgrounds and of walkways close to the open water schemes were often proposed.

Litter, pollution and silt accumulation in ponds and rivers were perceived as the main problems related to maintenance. However, maintenance of constructed open watercourses is a major barrier to the implementation of open stormwater management schemes. Undertaking the maintenance responsibility is often a complicated issue; in most of the cases examined there was wide debate between water authorities, road authorities, city councils, and developers (where active) on the adoption of the maintenance responsibility. This was principally due to

the cost involved. Other concerns about the implementation of stormwater management schemes related to the cost of land take and construction.

Another barrier both in the U.K. and Greece was the lack of knowledge and training in drainage design and landscaping of the surrounding areas amongst the "so-called" experts. Professionals are reluctant to introduce above-ground stormwater management schemes due to the fear that they might eventually be shown to be inappropriate, may raise public concerns, may increase fear over safety, or may be aesthetically unpleasant and unacceptable to the public. Public perception and acceptability, which is also influenced by public education on relevant issues, is also a barrier to the implementation of above ground water collection systems.

2 LITERATURE REVIEW – IDEAS INFLUENCING PERCEPTIONS OF WATER AND URBAN LANDSCAPE PREFERENCES

"The noblest of the elements is water"
— Pindar, 476 B.C.

"Water links us to our neighbour in a way more profound and complex than any other"
— Thorson, Indian Water Rights, Streamlines, 2003

2.1 INTRODUCTION

This chapter investigates in detail the trends and ideas influencing perceptions of water, urban design and landscaping, in an effort to understand the mechanisms which influence the formation of opinions. Chapter 2 provides the literature/theoretical background of the central ideas for understanding urban landscape perceptions and preferences related to the implementation of SUDS and river management practices in urban areas. The thematic structure of this chapter is maintained throughout the thesis, including the analysis of the results, when applicable, for reasons of consistency and better understanding of the ideas.

A broader understanding has arisen over the last few decades where a healthy environment can only exist within the limits of a healthy society and vice versa. This belief, which is shared by environmentalists, a number of politicians, and many other organisations, entails the ideas of environmental awareness, amenity, biodiversity, landscape preferences and sustainability. Human safety within their environment and their surroundings as well as public awareness of environmental interventions and their social acceptability are also important components of urban landscape development.

This broader understanding regarding degraded environmental conditions on a global and local scale has increased the levels of *Environmental Awareness* and concern among the public. Nowadays there is a common realisation that damage to the environment is causing a greater number of natural disasters, which directly affect natural resources and human and environmental well being. Water pollution from domestic, industrial and agricultural activities,

as well as a reduction of the quantity of water available to cover all uses will have devastating effects for the environment and the human population (UNESCO, 2003).

The concept of *Amenity* in contemporary thinking is closely associated to aesthetics, nature and biodiversity preservation, recreation and leisure. The term Amenity, deriving from the Latin word for pleasant *'amoenus'* has become synonymous with a valued public facility, to anything that brings comfort and pleasure to everyday life (All Words Dictionary, 2006). The Resource Management Act of New Zealand states that *"Amenity values are those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes"* (Ministry for the Environment of New Zealand, 1991). Creating natural environments within urban areas is often synonymous with introducing beauty in a city and improving the living conditions of local residents. The idea of amenity, which is sought not only in natural but also within urban environments, is incorporated in the ideas of landscape preferences. The trend towards the introduction of natural-looking features in urban environments was idealised during the romantic era, which arose from a cultural revolt against the effects of industrialisation, and was prioritised in the landscape design of the 19th and the 20th centuries. Nowadays, the trend toward designing and producing amenity landscapes, living environments which reassemble natural ones that are highly accepted by the public, is dominant in modern landscape architectural concepts. Although there is deviation in landscape preferences based on personal perceptions, interests, aesthetics, cultural heritage, and existing trends, there is a general tendency to envisage sustainable landscapes and constructions as those of high amenity value.

A basic element in designing sustainable urban landscapes, especially those incorporating water features, is the preservation of the existing *Biodiversity* and/or the introduction of new species - even those exotic to the area. Wildlife preservation and vegetation maintenance is an issue of high public concern regarding constructed ponds, wetlands and streams running through urban regions, as is highlighted by several researchers (Mungur et al., 1996; Kadlec & Knight, 1996) including the research currently presented. The tendency towards biodiversity preservation, which is prominent in designing water features within urban environments, is in accordance with the ideas of the ecology movement as expressed in the words of Aldo Leopold:

> *"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."* (Leopold A., 1966)

The association of *urban landscape ideas* and *landscape preferences* with perceptions of the environment and of water is prominent in current landscape architecture. Constructed landscapes within urban settlements are considered to be a means of reintroducing nature into city environments. These landscapes serve complex needs, the most important being the need to transform cities into more civilised places for living. However, the appearance of parks and open spaces with water features within urban areas is not a new phenomenon. Early parks were founded at a time when little was known about wildlife corridors and habitat continuity. The first parks were created to protect wild scenery, and there was little or no intent to promote ecosystem benefits. The first public parks in Britain, created in the 19th century, were seen as advantageous for health, and it was anticipated that they would reduce disease, crime and social discrimination. At the early start of the 20th century John Muir and Robert Underwood Johnson introduced the ideas of national parks as means of protecting natural scenery and wilderness, and stressed the necessity for increased aesthetics and conservation of the natural environment and the species within it (Nash, 1990; Muir, 1896). Nowadays the realisation of the need for transforming our cities into humane places, and introducing green areas that incorporate the ideas of amenity, biodiversity, and sustainability is becoming a major component in urban landscapes design.

A major concern associated with the introduction of water features in urban landscapes is related to the *safety* of the schemes. The public perception of risk is based on a series of parameters such as design characteristics, function of the scheme, operation and maintenance. Aesthetic and amenity features as well as education of the public play important roles in influencing attitudes over safety. One of the objectives of this research programme was to look into and evaluate the parameters formulating the safety concerns of SUDS ponds and open rivers in an effort to make suggestions on how to reduce risk and perception of risk, which is a deterrent to the introduction of open water schemes within urban areas.

Sustainability on the other hand, as a component of development that encompasses the ideas of amenity, ecology/biodiversity preservation, social acceptability and economic viability, has become a key factor in contemporary urban construction. Sustainable systems, such as SUDS and open rivers are gaining ground within modern developments. The sustainability concept, although it was first coined at the beginning of the 18th Century, is most closely associated with the UN's 1992 Earth Summit in Rio de Janeiro, and is perhaps most famously captured in Brundtland's 1987 definition as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs and aspirations" (Quoted in Bell & Morse, 1999).

Sustainable stormwater management systems (including sustainable urban drainage systems, known as SUDS and river restoration), as a component of sustainable construction, are also gaining ground within new planning concepts. Since the idea of sustainability is nowadays included in all sectors of public life and development, it is important to try and identify SUDS and river restoration as sustainable solutions for the treatment of runoff. Sustainability also finds applications in transport, pollution problems, climate change, health, education, economic growth, and employment.

Public participation and *involvement in the decision making* process, an essential element in water management and planning, can be seen as the means through which people are becoming better informed, participate in decision making, and are more positive in accepting change. It is a management approach constantly gaining ground among the engineering society and it has become a prerequisite in developmental and managerial projects, through a series of treaties and legislative regulations (UNEP, 1972; Brundtland Report, 1987; UNEP, 1992; UNECE, 1998; UN Millennium Development Goals, 2000; EU Directive2000/60/EC/WFD, 2000/60/EC; UNEP, 2002).

Public participation is the systematic process which allows people to influence the outcome of plans, working processes, and policy processes. At the same time it promotes social learning, democracy in water management through engaging an open and integrated system of governance, consensus building, conflict management and dispute resolution and it targets issues to achieve effective implementation of water policies. In addition, the procedures followed link water management with civic culture, addressing ethical and social dimensions of water management, building bridges between the parties involved or interested, and they try to identify and implement sustainable and durable solutions.

2.2 ENVIRONMENTAL AWARENESS & CONCERNS

Over the past decades society has begun to realise that environmental degradation is a global phenomenon and that protection of the environment is vital for maintaining the well-being of the planet. Ideas and trends towards environmental protection, and the recognition of the intrinsic value of different species and the landscape itself, widely expressed by several

thinkers, have influenced public perceptions and have raised environmental concerns. The evolution in environmental theories has also contributed in formulating public attitudes and strengthening the realisation that the survival of the earth requires effort from everyone.

From ancient beliefs to the idea of wilderness (Cronon, 1995) and romanticism (Coates, 1998; Jamieson, 2001), to modern landscape ideas and the development of new movements in urban design, public attitudes have evolved into concerns which led to the emerge of ecology movements (Fox, 1984) and set environmental and societal targets as basic requirements for development (Rio Earth Summit).

2.3 AMENITY

Today's landscape architecture, which many consider to be an art, embraces many different trends, bringing together current ideas of development. Architects, when creating a new landscape use this concept to try to justify the ecological, historical, emotional and functional needs of society. Open urban spaces have a role in transforming the aesthetics of a culture by establishing strong links between ecology, beauty, culture, geography, and local topography. Designers now include materials that express the natural landscape of the region and try to restore natural function to the environment. This involves developing new technologies to replace traditional engineering in drainage, such as SUDS, wastewater applications, biological treatment, and soil aeration.

These efforts, which are aimed at diminishing the loss of natural functions, and promoting the amenity value of developments are also at the heart of the sustainability issue by replacing damaging technologies with more beneficial ones (Johnson, in Thompson & Steiner, 1997). Such landscape design and planning also seeks to reduce the impacts of industrialisation, thus to minimise energy consumption and the consumption of natural resources (Laurie, 1997).

Amenity in contemporary thinking and design is closely associated with aesthetics, nature and biodiversity preservation, recreation and leisure. Having to recreate natural and sustainable environments is synonym with creating an aesthetic that brings beauty to a city. In the natural environment the call for conservation and natural function is a call for aesthetics (Ministry for the Environment of New Zealand, 1991). Even though natural landscapes are not always as clean and tidy as we would like them to be, designers have to find ways of making them

beautiful so that people will value and protect them. In this way people will not only accept sustainable solutions within their cities but they will also realise their importance.

For an area to be considered as an area of high amenity value, a sense of balance and interaction between people and nature is vital (Taylor, 1998). Sustainable environmental and conservation strategies need to be based on the need for a strong relationship between nature and urban dwellers. Although highly anthropocentric landscapes continue to exist, the creation of landscapes, which promote stewardship for the environment and support environmental consciousness, should be encouraged. A way to achieve this goal is openly to promote local community participation in landscape creation and maintenance (Dalton, 1994). In this way, the local community, in addition to expressing their attitudes on the landscape design, also undertake the responsibility of making the effort work and create an open space of real and not merely semantic amenity value.

One of the main issues with amenity landscapes is to produce a living environment that people like and accept (Taylor, 1998). Attitudes on landscape ideas differ widely among individuals. Their general perception, interests, personal aesthetics, cultural heritage, and existing trends, determine the way they envisage an acceptable urban landscape. Many people characterise wild landscapes to have a high amenity value, while others prefer landscapes to be more controlled and organised. For the latter, often a complete change of perception is required in order to see the beauty of nature in its pure form, with the least possible human intervention. On the other hand, wilderness supporters reject any kind of constructed landscapes as worthless, including ornamental gardens or exotic species introduced into the area, which for many years were used successfully in the quest for nature within urban areas (Jamieson, 2001).

The idea of wilderness in support of the preservation of nature and its aesthetics, can be considered, to some extent, to be embedded in the idea of Amenity. According to the Wilderness Act of 1964, an area of wilderness is an area untouched by man and his works, an area retaining its primeval character, affected only by the forces of nature where there is no noticeable human impact. The idea of wilderness can be included in anything 'natural' or resembling 'natural' features such as those that have survived as distant memories in people's minds ever since land has been discovered and mapped. However, nowadays, there few places on earth which are untouched by humans. The idea of 'natural' nowadays is more a matter of what is perceived as natural rather than what really is untouched by man. Still, the truth is that people often do not see what really lies in front of their eyes. What their minds interpret is

influenced by their cultural, educational and ideological background. Nature, while often fragile in practice, is durable in our imaginations. The social constructiveness of the term 'natural' is clearly depicted by the example of the Niagara Falls which under the influence of the "Romantics" movement and since the 1860s, has been repeatedly reconstructed to restore the natural wonder lost by the water diversions used for power and industry (Cronon, 1995) and to regain the element of amenity. Although, it is known that the Niagara Falls have undergone many changes so as to preserve the notion of wilderness and to attract visitors, for many, it has become the epitome of wilderness, a powerful natural feature of high amenity value. For others, it is a historic landmark, and a source of energy generation. The current trend towards anything natural and unharmed embedded in the idea of wilderness can be considered to have been clearly influenced by 18th Century Romanticism (Cronon, 1995).

The *Romantics'* art of the 18th Century depicted a turn towards respect for nature with Robert Burns, Sir Walter Scott, and Samuel Taylor Coleridge amongst the main representatives of this move. Romantic poets tried to connect the aesthetic and sensual enjoyment derived from the experience of nature with the notion of order and goodness. Shelley wrote poems about winds, clouds, and nature's laws. Between the renaissance and the start of the romantic period in 1800, the turn to nature and to the processes that characterise it, was seen as an alternative to the conservatism of religion, ethics, politics and the law. Ideas based on the concept that people are freed by nature but enslaved by man, were developed during this period and moved alongside the ideas of natural law, first developed by Stoics and revived after the medieval period (Jamieson, 2001).

The 18th Century finds many philosophers in search of tropical islands with locals who were part of nature, living in a natural state, unburdened by materialistic goods such as clothing and private property (Coates, 1998). Jean-Jacques Rousseau saw continuity between humans and animals and respect of other forms of life. In general, *Victorian Romanticism* saw the protection of nature and wildlife as a measure of humankind's higher order. Nature conservation had begun to have a major priority among the romantics of that era, John Stuart Mill, John Ruskin, and Lord Avebury (Dalton, 1994).

The *Romanticism* movement and the prioritisation towards amenity as important components of nature preservation and urban landscape preferences also found application in the design of urban open spaces of the 19th Century. The preference towards ornamental gardens in Britain and the 'Garden City Movement' are two distinct examples of this trend. The rise of the middle

class during the Victorian era, the invention of suburban living, and the increase in the amount of time the middle class could devote to leisure, also gave rise to the Victorian type of gardening. The underlying theme of the Victorian garden, as in much of Victorian life in general, was man's conquest over the elements, and details were designed to ensure high amenity value and increase the use of suburban open space for leisure (Hurd, 2006).

The 'Garden City Movement' was based on the ideas of Ebenezer Howard and a new form of town, expressed in his book 'Tomorrow: A Peaceful Path to Real Reform' (First Edition in 1898), 'Garden Cities of To-morrow' (revised second edition in 1902). The 'Garden City', as envisaged by Ebenezer Howard, was intended to bring together the economic and cultural advantages of both city and country living, with land ownership vested in the community, while at the same time discouraging metropolitan sprawl and industrial centralization. His books outlined his vision of social reform through a new type of living. He was concerned about the depopulation of the countryside and the poor quality of life in the cities. 'Garden Cities', could combine the qualities of the city with the best of the country, would provide everyone, poor and rich alike, with a healthy and beautiful place in which to work, raise families, socialize, and fulfil the responsibilities of citizenship. They would be places that would draw out the best in humans and allow the evolution of social consciousness and cooperation. Each town would be able to accommodate about 32,000 citizens and would be built in a circular way around a central park, while green areas would be mixed with the residential neighbourhoods (Glasscock, 2004).

The central park would be laid out as a beautiful and well-watered garden. Surrounding this garden, are the larger public buildings - town hall, principal concert and lecture hall, theatre, library, museum, picture-gallery, and hospital. The rest of the large space encircled by the wide glass arcade called the 'Crystal Palace' is a public park, which includes ample recreation grounds within very easy access for the public. The 'Crystal Palace' Runs all around the Central Park and opens on to the park. In wet weather this building is one of the favourite resorts of the people, and is therefore, used as a 'Winter Garden' (Howard, 1902). This new type of town planning was aimed at organising residential areas in a 'Romantic manner' where whole urban areas are surrounded by agricultural land, while the preservation of the beauty of the district secures the architectural harmony of the new buildings. Howard's ideas had a phenomenal impact on the British planning doctrine with its most impressive application being the plan for Greater London in 1944 and the creation of a ring of new towns beyond the London Greenbelt - following the passing of the New Towns Act of 1946. (Anon.b, 2004).

Engineers were influenced by the ideas of the romantics on amenity and natural landscaping and started adding characteristics which encompassed these ideas into their projects. Such an example is the case of Loch Katrine, one of the main water supply sources and a water treatment plant for the city of Glasgow. Since the 19th century this public works scheme has gradually been turned into an amenity feature for nature lovers and romantics. The beauty of Loch Katrine was famously celebrated as the silver strand in Sir Walter Scott's poem "The Lady of the Lake" in 1810. Since then it has become a favourite place of Scots and tourists visiting Scotland. The water supply works at the Loch, which began in Victorian times and have since been renovated, have always prioritised nature preservation and amenity value with a view to protecting these for future generations (Scottish Executive News, 2001).

The important heritage and amenity value of the Milngavie reservoirs has been a core principle for the renovation project, the main aim of which is to maintain the wild character of the area and restore the kind of woodland that nature intended there (Scottish Water, 2002). Influenced by the romantic movement in landscape architecture, engineers introduced romantic touches to the area (bridges, small castles, and gardens), thereby transforming the engineering structures into amenity features.

Interventions aimed at maintaining the amenity of the existing reservoirs have included reducing the visibility of tanks, reservoirs and other parts of the construction by planting trees and introducing embankments, fully or partially burying large parts of the buildings/structures to minimise noise and visual impacts, and using natural stone for the majority of the treatment building (Water Technology Net, 2006; Scottish Wild Land Group, 2006; Gerry Braiden, 2006). In addition, the public preference towards utilising the Loch Katrine area points to the importance of introducing amenity features into urban landscaping through innovative engineering construction incorporating the notion of utilitarianism, in this case the possibility of finding pleasure even in the constructed nature of urban environments.

The River Brent enhancement project, which formed part of the comparative study presented in Chapter 6 of this thesis, included restoring the river to its natural form and transforming the surrounding park into an area of high amenity value. The clear public preference towards this development/renovation of the river surroundings were expressed in public attitudes surveys both prior to the development (River Brent Enhancement Project Report, 1999) and afterwards as part of this project (Chapter 6). These surveys strongly indicated the trend in attitudes towards the adoption of environmentally friendly practices and the importance of amenity in

engineering construction. As in the case of Loch Katrine, the public preference of amenity features can be seen to reflect the influence of romanticism into construction, and the realisation of the need for creating apparently natural amenity features within urban areas.

SUDS ponds, especially when they are well conceived and designed, also create areas of open water within cities, and they introduce recreational features of high amenity and environmental value.

2.4 BIODIVERSITY

Closely associated with amenity is the biodiversity element of natural and constructed environments. Biodiversity preservation, as a means of maintaining equilibrium in nature, protects amenity and satisfies the requirements for sustainable development. Urban landscapes often have significant biodiversity potential including the flora and fauna naturally maintained in and around water elements. Constructed urban water features, such as ponds, wetlands and streams, often attract wildlife (birds, insects, small reptiles) and develop vegetation. The concept of biocentric equality, which sees humans as part of the community of species supports the idea that harming nature is equal to harming ourselves. The preservation of biodiversity is of major importance for life and well-being even within city environments (Naess, 1973; Bookchin, 1991).

In urban environments, where native flora and fauna is usually very limited, the preservation of biodiversity is even more important. According to Sessions (1991), modern humans have lost touch with nature, they live at a distance from whatever is natural, alienated from the rhythms of nature, and separating themselves from the world.

The notion of biodiversity emphasises ideas encompassed in biocentrism, such as the intrinsic value of all living beings, and is directly linked to nature preservation, which is embedded in the idea of wilderness. Urban semi-natural landscapes such as SUD ponds and urban rivers, are the expression of maintaining the "so-called" urban wilderness, which is important for preserving urban ecology and sustaining a humane living environment. The idea of wilderness can be considered to be embedded in the concepts of amenity and biodiversity, and the preservation of wilderness is often synonymous to the preservation of biodiversity and amenity. In turn, elements of preserving nature, amenity, and biodiversity are embedded in the

concept of sustainability, addressing the elements of social and ecological stability and providing self-maintained and economically viable ecosystems which appear to be natural.

2.5 LINKING AMENITY & BIODIVERSITY TO URBAN LANDSCAPE IDEAS AND PREFERENCES

2.5.1 The need for public open spaces within cities

Since the 19th Century, urban design has taken natural processes into consideration and urban landscape design now are aims to improve wildlife habitat, stormwater retention and water quality issues (Bradshaw and Chadwick, 1980 in Schauman & Salisbury, 1998).

At the beginning of the twentieth century modernism was also introduced to landscape architecture. Modern structures and open spaces replaced the romantic garden of the past.

Cities are also in a constant state of transformation. People leaving the city bring their familiar romantic landscape with them, while people returning to the city try to recreate a beautiful and habitable environment in the suburbs, an environment which they have a sense of pride, place, history, safety, good housing, friendly parks and open spaces. The urban landscape of today is a collective of expectations, responses and remembrances (Johnson, in Thompson & Steiner, 1997).

Additionally, in recent years, ideas of green networks, protecting or enhancing natural resources, and creating open urban spaces of high recreational value are gaining ground in the architectural design of open space. Urban forestry, community forests, improvement of urban landscape are all concepts which are gaining ground in urban development and they make a significant contribution to the practical application of sustainable development (Blowers, 1993). The latest concerns over environmental degradation have influenced the perception of urban design. Planning for sustainable development includes land use which enhances landscapes and protects the natural environment and wildlife habitats. It is therefore necessary to view environmental planning as an integrated process moving around the idea of sustainability.

Nowadays many people are drawn to parks and open green spaces not only from interest in the sustenance of ecosystem integrity but also, and principally to admire the beautiful landscape. Although this in necessarily a problem, it could at the same time be considered as one. The problem lies in the fact that urban open spaces attract people and development only for their

aesthetic value thereby imposing a kind of development that could threaten ecosystem integrity. Landscape architecture today aims to developing policies in which ecological protection is promoted and safeguarded within 'urban green spaces'. Ecological restoration has become one of the most important issues in landscape design both for city and regional landscapes. This type of design recognises the need for respect towards the local biophysical characteristics and allows the necessary interaction of organisms within the local ecosystem (Hough, in Johnson, 2002).

The need for urban citizens to live close to nature is clearly demonstrated through the current trend in housing development which promotes the idea of the 'new model village', popular amongst planners as 'sustainable communities'. Such developments are usually placed in suburban areas and try to recreate rural sceneries, with small ponds (often SUDS ponds) or little streams and are rich in tree and flower vegetation (Freedman, 2003), which can be linked to the idea of reviving of the Garden City movement of the 19th century. Such developments create humane environments while at the same time serving the practical needs of the community, such as drainage and provision of space for recreation.

2.5.2 Urban Open Space Design

Many modern environmentalists consider the city as the bridge between civilised man and the raw material of the surrounding land, and make proposals for the reestablishment of the lost connection between humans and nature. This promising approach proposes an ethic of nature which pays special attention to moral concepts such as respect, sympathy, care, concern, compassion, gratitude, friendship, and responsibility (Van De Veer, 1998; Jamieson, 2001). According to these ideas the city provides the source of energy for the world around it and men facilitate the change from natural resources into fabricated products. Traditional and contemporary ethical theories could also be extended to include animals, plants, and inanimate natural features (Gunn & Vesilind, 1986).

However, despite 'progress' in the late nineteenth century in the name of 'civilisation', forests continue to disappear and urbanisation has resulted the loss of natural wilderness. Nature lovers became increasingly horrified by the effects that industrialisation, tourism, and the whims of fashion have on the animals, plants, and natural landscapes of Europe and North America. For them, the only way of saving nature from industrialisation was to preserve it in reservations,

parks, and urban open spaces. At the same time there was another conceptual turn towards romanticism and wilderness conservation, ideals which are often sought within urban open space environments. Although there was a significant turn towards nature preservation and protection in the twentieth-century, the modern 'Garden of Eden', the 'Garden City Movement', still produces the enclosed shopping mall decorated with trees, flowers, and fountains are the main water features. In these malls people can shop for 'natural products' while the walk in 'nature' is synonymous with the walk in urban or suburban parks, with their ponds, streams or rivers. Existing vegetation and wildlife are often exotic for the area and could by no means be considered as 'natural' (Van De Veer, 1998).

The apparent semblance of natural landscapes is vital to enhance acceptability by the public of those new artificial open water features and the new types of sewage works, industrial ponds, reservoirs, and canals or rivers in the urban environments. Within the concept of sustainability, these features can take the form of amenity lakes and gardens which are actually unrivalled in the surrounding countryside, with great importance for wildlife.

Such systems can be used to treat industrial and polluted runoff which often has high levels of heavy metals and nutrients. Additionally, they can be considered as a sustainable approach to drainage (SUDS and urban open rivers). A major issue for urban wetlands and ponds is how these urban water features can be modified to support wildlife, and, even when this is achieved, whether higher priority should be given to function or to amenity. The modification of shorelines according to topographical variation and characteristics of the area is recommended as well as the creation of islands within these water features and the support of natural treatment processes for biodegradation. The introduction of plant species, such as reed beds, for organic mass decomposition is also used to secure the desired biological water treatment facilities (Kendle & Forbes, 1997).

Wetland vegetation and wildlife are crucial issues for the design and establishment of urban water bodies within urban areas. Most landscape architects share notion that native plants favour wildlife and are more easily established than exotic ones. However, preference should be given to places where human control over ecosystems is minimised and where plants and wildlife (both native and exotic), once introduced, are free to interact.

The human impact on urban landscapes is overwhelming and results in the formation of specific plant and animal communities. Most plant and animal species present in urban landscapes are exotic species, often ignored or undervalued by ecologists and landscape architects. However

unnatural the urban flora and fauna may be, it is usually welcomed by local residents who do not share the prejudices or preferences of professional ecologists, and are open and often enthusiastic in accepting colourful exotic plants and attractive wildlife species within their residential area. The climatic and geologic conditions of the site play a very important role in the establishment and support of exotic or 'alien' species, as they are frequently called, within urban open spaces.

It has been estimated that 60-70% of urban vegetation has been deliberately introduced, and landscape styles vary from semi-natural to exotic. Hitchmough (1994 in Kendle & Forbes, 1997), describes the characteristics of naturalistic or ecological styles of landscape design as:

- Low-cost sustainable landscapes;
- Landscapes of high intrinsic value for the area;
- Landscapes which are in contrast to ornamental style;
- Landscapes of minimum maintenance requirement;
- And, finally, landscapes of high conservation, educational and recreational value.

A very sensitive point for naturalistic landscape architecture is the fact that most man-made urban landscapes are modelled on relatively immature communities whereas landscape development should be considered in terms of good long-term management. The latter point applies to SUDS in new housing developments and/or river restoration schemes. One of the main advantages of man-made landscapes compared to natural landscapes is that the possibilities and opportunities for enhancing human contact with nature can be maximised through proper design. They can be located in areas with good public access and social interaction. One study, aimed at examining public awareness and preferences for urban land use and landscape change around growing towns, was carried out by researchers at Wye College in London, at Ashford in the county of Kent. This research demonstrated that people use countryside close to their residential areas for recreation and prefer such "beauty spots" to be protected. However, public attitudes towards landscapes and green open space design differ between countries. For example in Britain people appreciate landscapes with panoramic views with hills, woods and lakes while in Japan, people take pleasure in noticing the details of trees and flowers (Anderson & Meaton in Miller & de Roo, 2000).

Johnston (1990 in Kendle & Forbes, 1997), suggested a series of considerations for man-made urban landscapes:

- Retention of existing vegetation;
- Utilisation of available opportunities such as aspect and gradient;
- Provision of variety and interest through landscape design, vegetation structure and colour;
- Consideration of physical characteristics and underground services;
- Provision of open space for a variety of uses;
- Separation of sanctuaries and sensitive wildlife areas from those with greatest activity;
- Promotion of links to other open spaces;
- Provision for special needs in the community;
- Anticipation of changes in vegetation as it develops;
- Siting of facilities, such as notice boards, fencing and nature centre;
- Locating access points and paths on desired routes as far as possible;
- Consideration of management and financial implications of the design.

Public perception surveys on SUD ponds and wetlands in UK (Apostolaki et al., 2001 & Apostolaki et al., 2002) have shown that the design of the landscape around urban water bodies should have the same characteristics.

2.5.3 Multifunctionality of Urban Open Space, SUDS and open rivers

In general, people of various cultures prefer public landscapes which are natural environments to built environments or to those environments where human impact is very obvious (Ulrich, 1993). Although human influence is often appreciated, to be well perceived it has to be in balance with natural features (Strumse, 1994). According to Ulrich et al., 1991, the stress releasing ability of natural landscapes can be considered to support a kind of evolutionary

theory on landscape preferences. However, landscape preferences are influenced by several parameters such as age (Balling & Falk, 1982; Lyons, 1983; Zube et al., 1983), educational level, and occupational interests (Yu, 1995).

There are various reasons why people express preference for specific landscapes or to protect landscapes; landscapes at times are considered to serve human needs while at other times they are considered to be of high ecosystem value. Frequently a combination of the two reasons urges people to protect landscapes or influences their preference towards natural like landscapes (Kaltenborn & Bjerke, 2002).

The regeneration of ecologically degraded urban landscapes into apparently natural areas also serves a number of functions; conceptual (establishes a link between urbanism and nature), cultural, ecological, social, psychological, and aesthetic. The social and cultural value of open space is often considered as the driving force for their creation (Tress et al., 2001).

a. Conceptual Function

A common attitude towards 'green open spaces' is the beneficial character of contact with nature. Overall the benefits gained are considered to be:

- A sense of integration in society rather than isolation;
- Reunion with nature;
- Restoration and relief from daily struggle;
- Skills development and motivation to participate in environmental care. (Rohde & Kendle, 1997)

Although modern urban areas are multicultural societies, the benefits recognised for ethnic groups still apply to individuals and, in reflection, for the group as a whole.

Along with the aforementioned benefits, contact with nature delivers a series of psychological benefits for humans by maintaining a standard of psychological well being expressed on different levels:

- Emotional (through stress reduction);
- Cognitive (through reduction of mental fatigue);

- Developmental (through an educational role by encouraging higher levels of mental activity, especially for children);
- Behavioural (through encouragement of exploration);
- Social (through contact with other individuals who use the same open spaces). (Rohde, & Kendle, 1997)

b. Cultural Function

Landscapes bearing the impact of human activity can be considered as cultural landscapes. There is growing interest in cultural landscapes amongst planners and designers and a move towards planning which bridges human and natural activities and sees humans as part of nature. From this perspective, cultural landscape design accepts the fact that human impact on ecosystems is more harmful than that of any other animal species. However it is still a natural process (Taylor, 2002).

The influence of cultural history as a factor, which continuously shapes the landscape, is widely recognised. An ecological view of how a new landscape should be seen is the one which allows retention of the history of the area. Landscapes are constantly modified through history and follow the current trends of each era. Consequently, heritage plays a very important role in landscape design and in the way people value places. The perception of a place is the result of the upbringing of the individual, their general perception of nature and life, and the way they view the environment culturally. Consequently, attitudes towards open spaces differ. Parks for example, are seen as healthy and safe places by some, where one can come into closer contact with nature, by others they are viewed as locations for crime. Although for some, parks are places for active sports for others such activities disturb the tranquillity of the place and reduce the value of the landscape as a place for leisure.

c. Ecological Function

There is wide conflict amongst landscape architects as to what constitutes 'truly ecological landscape architecture', principally in what appears to be 'ecological' and 'natural' in landscape design. Some architects support the use of native ecology within urban open spaces while others are advocates of the introduction of more exotic species. In any case landscape architects have the ability to construct nature both literally and figuratively, although the landscape architecture of the twentieth century was more of an approach to forms rather than to ideas and expression.

Today there is a recognised struggle to redefine nature, which is also a facet of landscape architecture. Despite the existence of a wide range of opinions on how to define 'natural', there is international concern about the future environment and the reintroduction of nature into urban environments. To characterise a landscape as either 'natural', 'artificial' or 'cultural' we overlook the holistic idea that desires landscapes to be influenced by all these factors. (Whiston Spirn, in Johnson, 2002)

d. Social Function

According to many, one of the main social benefits of public open spaces and urban parks, is the fact that these are the places where democracy is worked out, 'on the ground'. Since ancient times public open spaces have been used as the places where democracy was practised and political rhetoric speech was developed. In the nineteenth century, the park was seen as a place of unification and democracy, described as *"a kind of democracy, where the poor, the rich, the mechanic, the merchant and the man of letters, mingle on a footing of perfect equality"* (Schuyler, 1986 reflecting Olmsted's views).

Today, although the democratic process has changed and is not practised in parks or other public open spaces, different cultures can find individual expression, a mosaic of our urban culture in such places. It seems that the preferred type of open space in the 21st century is a place where urban citizens can have some basic form of exercise, even merely walking around. Corraliza (2000) after he carried out research on preference for 'pathways' and 'parks or plazas' found out that people (at least in Spain) preferred pathways. He also suggests that there are many more opportunities to engage with other people and with the environment in streets rather than in urban parks, which are possibly becoming places for particular categories of people, for example, children and old people. However, this attitude is a subject of further research.

Public space could be considered as outdoor rooms within a neighbourhood, a place to relax, and enjoy the urban experience, while at the same time one can become engaged with a range of different activities. Common recreational activities taking place within public open spaces include outdoor eating, street entertainment, sports, children playing, walking or just sitting. It is widely known among landscape architects and urban designers that public spaces work best when they succeed in establishing a direct relationship between the space and the people who live and work in and around it.

According to Ward Thompson (2002), the main factors which have to be taken into consideration when designing public open spaces are:

- the technical revolution, centred on information technology and global to local networks connecting people;
- the ecological threat, with its implications for the importance of sustainable development;
- the social transformation, with life patterns reflecting increasing life expectancy and new lifestyle choices.

(Ward-Thompson, 2002)

e. Psychological Function

Urban societies today are considered by many to have lost contact with nature (Airaksinen, 1992). On the other hand, on a psychological level, access to nature within the city is considered to be beneficial. Olmsted suggested that failure to provide natural relief within the urban environment, through open spaces could cause substantial negative effects on health in the long run (Kaplan and Kaplan, 1989).

If only for psychological reasons, open public spaces and parks are considered as beneficial in terms of quality of life. For many urban citizens, the concept behind urban parks and ponds resembles the concept of returning to the 'Lost Eden', the 'Garden' in which contact with nature can take a metaphysical or spiritual dimension, even at a subconscious level.

To understand this concept one has to see urban open spaces as places for meeting strangers, interacting with other people in a relaxed environment at the same time being able to be intimate, anonymous and therefore private. Urban citizens, even subconsciously, have the feeling that they are in contact with nature, and that the environment around them is healthier and therefore contributes to enhancing the quality of their life within their area. The mutual relationship between people and the landscape is vital for the existence of urban landscapes. Not only do people influence the landscape, but landscape also influences people (Tress et al., 2001).

According to Ward Thompson (1998), in our cultures, histories and psyche, the park symbolises a refuge or paradise. We often believe that the park is a place of freedom and non-threatening

nature. However, a park can also be a place of fear and anxiety for many. Although open spaces provide a sense of freedom and relaxation, they also include dangers. The safety risks in urban open spaces vary and derive mainly from the fact that such places are indeed uncontrollable, providing an area for criminal attacks, especially against women or the elderly, or children having accidents while playing (Ward-Thompson, 2002).

The distressing ability of nature can also be considered as a means of improving psychological and, as a result, physical health. In addition, the vitality of green open spaces available from contact with urban wildlife has direct benefits for the well being of urban citizens (Tress et al., 2001).

f. Aesthetic Function and Personal Preference

To define what makes scenery look beautiful and acceptable is not an easy task. As cities developed through time, the perception of what is acceptable and aesthetically pleasing continuous changed. For centuries the city was seen as a delivery and disposal system, a network created to support commerce and culture. In extension, bridges, roads and sewers are built without much consideration for the environment. The need for a clean and tidy city emerged during the Renaissance when people realised that filth and dirt in the city roads is responsible for disease. As cities became cleaner, the landscape was romanticised. Historically, in urban design, native landscapes were replaced by romantic ones, and ornamental gardens, i.e. British gardens, became fashionable and were considered as a landscape innovation.

In the mid 20th century, a dominant concern with the visual quality of the landscape was born. Colvin (1970) argues that this concern is combined with an attempt to demonstrate the relationship of human nature with landscape beauty. Art and landscape preferences are clearly influenced by the technological advances of the era. On the other hand efforts were made to link landscape architecture with the fine arts.

In the past two decades there has been an extensive debate between 'scenic' and 'ecological' aesthetics in landscape design, with ecological aesthetics becoming more and more important for landscape planners. Ecosystem principles such as biodiversity and sustainability are the main values of ecological aesthetics and have to be taken into account when designing new urban landscapes. Most importance in scenic aesthetics is given to aesthetic preferences, thereby undermining the importance of ecological benefits. For many this results in the creation of superficial landscapes with no regard for wildlife and plant populations. For the advocates of

ecological aesthetics, scenic aesthetics are to some account morally inferior. As Aldo Leopold stated *"a thing is right when it tends to preserve the integrity, stability and beauty of the biotic community"* (Parsons & Daniel, 2002).

However, our notion of ecological landscapes is not just influenced by our aesthetics and senses as much as indirectly by our knowledge of the ecosystem's health and sustainability. The conflict between scenic, romantic landscapes and ecologically raw and unrestrained landscapes has always been an issue in human societies (Appleton, 1975).

While on the one hand there is a congruent split between 'urbanists' and 'ruralists', on the other hand, aesthetic and amenity issues tend to be overshadowed by larger environmental concerns. Beauty and use are now intrinsic in the idea of sustainability. The ecological approach that became popular in the 1970s and 1980s, which claims that humans would benefit in psychological and social terms from contact with naturalistic landscapes of rich biodiversity, is becoming increasingly popular especially within the concept of sustainability. This trend is clearly depicted in Figure 2.1, which demonstrates the interrelationship between environmental, social, and aesthetic values.

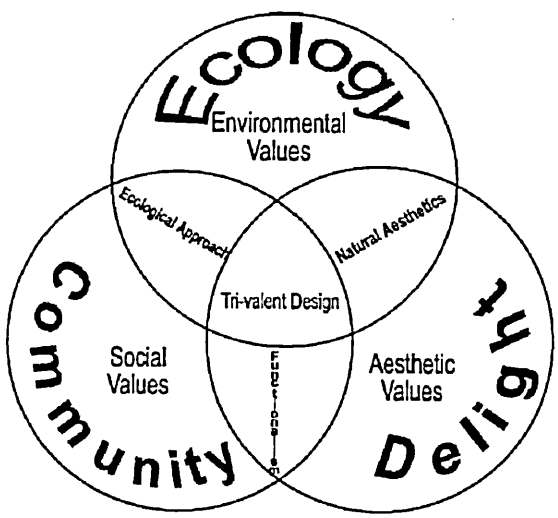

Figure 2-1 Conceptual overlaps between the three value areas: ecology, community, delight. (Thompson, 2002)

The tri-valent design combining an ecological approach which has high natural aesthetics and functionalism, can be found in SUD ponds and river restoration or natural river management schemes which reflect the notion and encompass the benefits of multifunctional open spaces. These systems provide environmental benefits through the vegetation in and around them and the wildlife attracted by them. Community benefits such as the provision of areas for gathering, socialising and using the surrounding area for recreation, and the aesthetic benefits of the area

through the provision of natural-looking environments are in general highly appreciated by residents.

2.6 LINKING PERCEPTIONS OF WATER, SUSTAINABILITY AND OPEN WATER CONSTRUCTION

2.6.1 Perception of water and safety

Water is one of the most important aesthetic elements of the landscape. It is one of the most obvious elements with which people tend to have a very direct relationship. A common characteristic of any human society is that communities tend to settle near water (Appleton, 1975). Of course, landscape characteristics are crucial in influencing attitudes and acceptability of water bodies within residential areas, rural and urban.

Modern citizens tend to prefer natural to urbanised environments. According to Parsons & Daniel, (2002) people in the USA show preferences towards open areas with native vegetation and there is direct or indirect access to a watercourse, a pond or a stream. In general, people favour open space with an obvious presence of water either in the form of a river, a stream or a lake. This trend also demonstrates the preference for undeveloped and untouched landscapes as well as the need for recreational areas within a city since many associate recreational activities with water environments (Garoeren & Rudoell, 1991).

Litton (1977) referred to the visual assessment of river landscapes: *"Water in the landscape tends to be dominant because of its visibility, its movement, reflections, and colour, its consequent contrasts to adjacent earth surfaces."* However, the acceptability and perception of the visual qualities of water is influenced by many parameters that are worth examining.

According to Shafer and Brush (1977), water may have a negative effect on scenic value if it occupies a proportionally large part of a scene. Additionally, children generally tend to perceive and evaluate water differently from adults. Zube et al. (1983) found that water significantly enhances scenic values for young children but is of minor importance to adults. Children are tend to be fascinated by rivers and they often focus their attention to the details of a river landscape, while adults pay more attention to the 'big picture' (Tapsell et al, 2001).

Yamashita, (2002), studied the perception of water in the landscape of adults and children in Japan. The public opinion of a river landscape was assessed using a photo-projective method

(PPM). One of the main outcomes was that children, and especially children of an average age of around 11, tend to be more attracted to water than adults or younger children and consequently they approach the water body more closely. Children who demonstrate a strong fascination to water often retain this preference through water sports and recreation. (Kates and Katz, 1977; Tuan, 1978). It is interesting that the same study found that adults pay attention primarily to flow rates and they strongly relate the water landscape to the features of water. On the other hand, children seemed to be more concerned with water quality. This difference in perception indicates the ability of adults to identify a variety of visual conditions, while children demonstrate a rather primitive interest in water.

Musacchio & Coulson, (2001) investigated the public perception of a water body, a river in this case, and showed that local residents associate the local water body to its surroundings and this even includes the built area around it. Another finding of this study was that farmers and long-time residents show a preference for farms and developed areas while new residents and non-farmers are attracted to more natural landscapes. The physical distance from the watercourse also plays an important role in formulating attitudes towards the water body. Residents with direct access to watercourses focus on water quality issues while those living further away are more interested in the visual characteristics of the landscape. Additionally, there are indications that people are attracted to natural landscapes and move closer to these features either for more direct contact with nature or in an effort to live in places which resemble natural landscapes.

The aesthetics of water bodies seem to play a crucial role in formulating public opinion and should be taken into consideration in any landscape-planning. Research on perception of water bodies in urban areas has demonstrated that aesthetics of river landscapes, wetlands, and open stormwater structures in the form of detention or/and retention basins and open channels influence public attitudes towards the systems. Water bodies of high aesthetics are perceived to function better, to be beneficial for biodiversity and to be safer for public use. However, residents prefer to have a say in the landscaping of open water systems and have an active role in the design of open water systems (Hjerpe & Krantz, 2000). In general, natural or apparently natural wetland and river landscapes are preferred to constructed landscapes for aesthetic reasons and perceived efficiency and safety (Apostolaki et al., 2002). The attributes associated with the attractiveness of water bodies include naturalness, interest value, inclination to explore the scene and its use for recreation, lack of human interference, vegetation diversity, and shoreline complexity. Although most people do not oppose the idea of using urban water bodies for treating wastewater, any disturbance to wildlife and native vegetation causes great concern,

demonstrating public appreciation of biodiversity (Mungur et al., 1996; Kadlec & Knight, 1996).

Flood defence works aimed at reducing flood risk in urban areas are increasingly based on open water structures, either in rivers or SUDS as part of an integrated approach (Howe & White, 2002). However, such systems has raise concerns related to function, operation and maintenance, aesthetics and design, biodiversity benefits, cost and safety. Most members of the public agree that the systems should be highly functional, they should be maintained properly to reassure consistency in functionality, their design should enhance aesthetics and biodiversity while at the same time diminish safety risk (Apostolaki, 2002; Hjerpe & Krantz, 2000).

The safety of open water bodies located within residential areas is a major concern. Modern people have lost contact with nature to a certain extent and often feel threatened by water bodies close to their homes. Since most urban citizens are unaware exactly how to behave close to water, especially where children are concerned, it holds a perceived fear. Most urban residents consider open watercourses as a safety risk for children and pets. Children often perceive rivers to be dangerous. These attitudes are often based on adult perceptions, transferring the fear of open watercourses to their children. However, these concerns often reduce when children spend time around open watercourses and benefit from the opportunity for exploration and play (Tapsell et al,2001). Risk and any vivid memories of unpleasant events seem to be the main issues of concern especially with open water structures. Accidents involving children and pets raise negative press coverage and turn local residents against open water structures, as for example in the case of Halbeath pond, a retention pond in Scotland, where an incident of a dog drowning caused a public outcry against the pond (Apostolaki et al., 2001).

Damage to, and destruction of nature do not occur outside personal experience, although this has happened in the past especially in cases of nuclear accidents kept secret for a long time. Instead there is an increasing trend towards freedom of information regarding damage to nature and everyday life risks associated with construction and the environment. Not only does this raise awareness but it also increases the perception of risk. Science determines 'risk' while the critique of civilisation, technology, environment and construction, helps citizen to perceive 'risk'. The perception of risk often lies in the fact that people are not well informed and are easily terrified; if people had the technical knowledge of experts they would in many cases be less concerned over safety (Beck, 1992). The key to influencing perceptions, eliminating the

concern of risks and even improving technical design and construction is through consistent communication and information (Irwin, 2001; Apostolaki et al., 2003).

Understanding risk also bears a close relationship with the cultural global views of individuals or their gender. Women are generally more anxious over environmental issues and the risks involved and this can be explained by their heightened concerns over children's welfare. The possible communication gap between experts on sustainable development and the general public may also be responsible for public negativity and the rise of relevant risk concerns (Irwin, 2001).

2.6.2 Sustainability

As an idea, sustainability can be traced back to environmental ideas which began to emerge in Europe about 3 centuries ago. The idea was first introduced in 1713 by H. C. von Carlowitz, a forester who believed that storing wood could help to sustain the continuous exploitation of forests without jeopardising their viability. In 1795 the German forester Georg Harting, was the first person to utilise the term 'sustainability of yield', to describe the need to preserve wood for future generations. He believed that to achieve sustainability of yield, the rate of cutting trees should not exceed the growing stock (Galanos & Albanis, 2000).

Sustainability, as it is understood today was introduced and explicitly explained by the Brundtland Commission in 1987 (The World Commission on Environment and Development - WCED). The Brundtland Commission identified unequal development as the cause of environmental degradation (Holmberg et al, 1991), and prepared the ground for the United Nations Conference on Environment and Development (UNCED) and the signing of the Rio Declaration. Four meetings, were held between the summer of 1990 and April of 1992 – first in Nairobi in August of 1990, second in Geneva in March of 1991, third in Geneva again in August of 1991 and forth in New York in April 1992 – in preparation of the UNCED, better known as the *"Earth Summit"*, held in Rio de Janeiro in June 1992 (Huckle J. & Sterling S., 1996). Representatives of the governments of 150 countries and 6500 non-governmental organisations participated at UNCED. The Declaration on Environment and Development, signed by the participating countries, contained 27 principles, confirming that the environment and development are inseparably linked at a global scale.

However, there is a general lack of agreement about what exactly 'sustainable development' means. There are over 200 definitions of 'sustainable development', the most frequently quoted

defines sustainable development as development in which total '*welfare*' does not decrease over time and the development of one nation or group of individuals does not jeopardise the '*welfare*' of another nation or group.

Agenda 21 was introduced during UNCED, to set the framework for cooperation of governmental and non-governmental organisations in achieving the aims of sustainability which are to eradicate poverty and establish a healthy environment in all aspects of human life. Agenda 21 is a guide for business and government policies, as well as for personal choices into the 21st century. It includes 40 chapters dealing with the earth and all human matters. It provides options for combating degradation of land, air and water, conserving forests, oceans, mountains, and the diversity of species. It also deals with poverty and excessive consumption, health and education, agriculture, cities and farming. Agenda 21 envisages that poverty can be eradicated by ensuring that underprivileged people have access to resources to ensure life and well-being. Since the publication of the Brundtland Report (1987), and after the Rio Declaration was signed, the concept of sustainable development has achieved widespread popularity and has become a fundamental goal.

Although development is often confused with growth, the two ideas are different. Growth is associated with physical or quantitative expansion mainly in an economic sense. In contrast, development is a qualitative concept including the notion of economic, social, and cultural improvement and progress all having an environmental dimension. Consequently, sustainable development is development that is designed and aimed at providing a holistic approach to all interrelated sectors of life and well-being. It is the conservation and improvement of all resources within communities, to secure stability for generations to come.

For development to be sustainable, certain goals must be pursued:

- Resource conservation, aimed at ensuring the supply of natural resources for present and future generations through the efficient use of land, less wasteful use of non-renewable resources, their substitution by renewable resources, and the maintenance of biodiversity;

- Sustainable built development, aimed at ensuring that construction makes use of the technological advances which preserve the environment and are in harmony with the natural environment;

- Social equity between countries and generations, aimed at preventing any development that increases the gap between rich and poor and at encouraging development, which reduces social inequality;

- Political participation, aimed at changing values, attitudes and behaviour by encouraging increased participation in decision making and in initiating environmental improvements at all levels from the local community upwards (Blowers, 1993).

To meet sustainability objectives, policies must be *'greened'* and reflect public attitudes and the public need for information and participation. Public education and community involvement are essential ingredients in any environmental strategy.

This new kind of development, apart from changes in policy and education, also requires new design approaches to incorporate environmental considerations as inherent and inseparable parts of the design process. Environmental considerations need to be integrated into engineering design just as economic considerations are. Sustainable design is top of the list for incorporating minimisation of the use of materials and maximising energy savings. New developments should also fit into the environment harmoniously with minimum disruption or degradation of natural ecosystems. Design engineers should apply safety factors not only to compensate for uncertainties about the strength of their structures, but also to compensate for uncertainties about the environmental consequences of the construction. Such changes imply the need for a new engineering philosophy and ethic, and consequently for the need for changes to engineering education (Beder, 1993).

Within the concept of sustainable development, re-creating the relationship between nature and people will be achieved through social and environmental justice. The idea of combining the natural and urban environments is a concept central to the core of sustainability, and was first introduced with the Garden City Movement in the 19th century. In other words, sustainability restores to the human mind and spirit, the living connections between humans and the planet and everything in, on, and around it. This implies sensitivity towards all living beings and life processes. In addition, it places humans at the centre of the planetary sphere, with physical, social, aesthetic, and ethical entities (Hoyt, 2000). Sustainability is also the way through which people could organise the existing economic and political capabilities to fulfil basic needs for food, clothing, shelter, and energy, and to provide security for health, jobs, education, children,

and old age without underestimating the need for preservation of the natural environment. The partnership between humans and non-human entities is one of the basic targets of sustainability.

This turn towards sustainability and respect for nature is demonstrated by the needs of modern man to experience contact with pristine places or for places of intrinsic natural value. Although surrounded by buildings modern city man seeks ways of escaping into nature. Parks and constructed ponds or wetlands, within or close to urban areas artificially create nature. Other examples such as artificial snow in ski resorts, parks of rich biodiversity value, or eco-tourism sites are becoming more and more common in the western world. However, a common view of modern society is that the entire world, including nature, is artificial and controllable. On the other hand, although this modern view of artificial nature inspires melancholy, there is a post-modern attitude for minimising the dichotomy between the natural and the artificial. Strangely enough, such artificial experiences, while doubtful in retrospect, seem real to many people. They are accessible for thousands at the same time, and if they are engineered with care and sophistication, they create emotions similar to those emerging from contact with 'real' nature. When nature is separated out from human everyday activities, it even ceases to be nature in any full and effective sense. Nature can be eloquent in parks and gardens and can even be present at the very centre of our houses (Graber, in Soule & Lease, 1995).

The need to reform the city in a way which creates the essence of contact with nature which is necessary for modern citizens, is often seen in the introduction of open water features and green areas in cities. SUD ponds and river restoration projects include element of sustainability in the sense that they provide obvious environmental and social benefits, while their low maintenance costs are economically efficient. Although there is wide debate on whether SUDS and open rivers are sustainable or not, there is a general trend in perception within engineering society that such systems are more sustainable than traditional drainage systems.

2.6.3 SUDS as a component of urban open space design and sustainable construction

Introducing ecological or sustainable solutions in urban design contributes to society's ecological objectives. For real benefits from the integration of nature within urban areas, the dichotomy of town and countryside must be broken. Nature should be recognised as an integral part of urban life, and human life as part of nature. A clear vision of the relationship between people and wildlife within the concept of urban environment is the way forward.

Apparently natural structures and sustainable practices such SUDS, especially SUD ponds and wetlands located within urban areas and river restoration practices, can help in re-establishing the relationship between modern man with nature and water bodies.

Although there is debate over the sustainability element of SUDS, there is agreement amongst the engineering fraternity that, even though it is not entirely sustainable, using SUDS is still a more 'sustainable' approach that encompasses the concept and elements of sustainable development more than traditional drainage. SUDS are considered to be beneficial for the environment and society while at the same time they are cost efficient, with construction cost comparable to that of traditional drainage and minimal operational / maintenance cost.

SUDS provide flows attenuation and reduce the risk of flooding while at the same time they serve environmental, biodiversity, and amenity needs of the city and urban citizens. SUDS are often considered in new developments to provide sustainable drainage solutions and are part of the new trend within landscape architecture.

The United Nations and the World Bank and a number of environmental organisations worldwide such as the USEPA, consider that the collection and treatment of runoff is necessary for environmental and hygienic reasons and as a step towards sustainability. The word sustainability itself, declares the importance and the multipurpose nature of stormwater management. Using SUDS is a sustainable way of treating runoff, with environmental, social, and financial benefits.

The new term SUDS includes the concept of sustainability. SUDS aim to:

- Introduce runoff treatment that is cost and energy efficient;
- Improve amenity value to its surrounding area;
- Introduce beneficial stormwater management techniques which promote biodiversity.

A simple way of describing SUDS is to use the sustainable development 'three-ring model' (Butler, 2002) which draws on the intersection between the social, environmental, and economic goals of sustainable development and is based on the same model which encompasses the target areas of sustainable urban drainage (Jefferies & Bray, 2003).

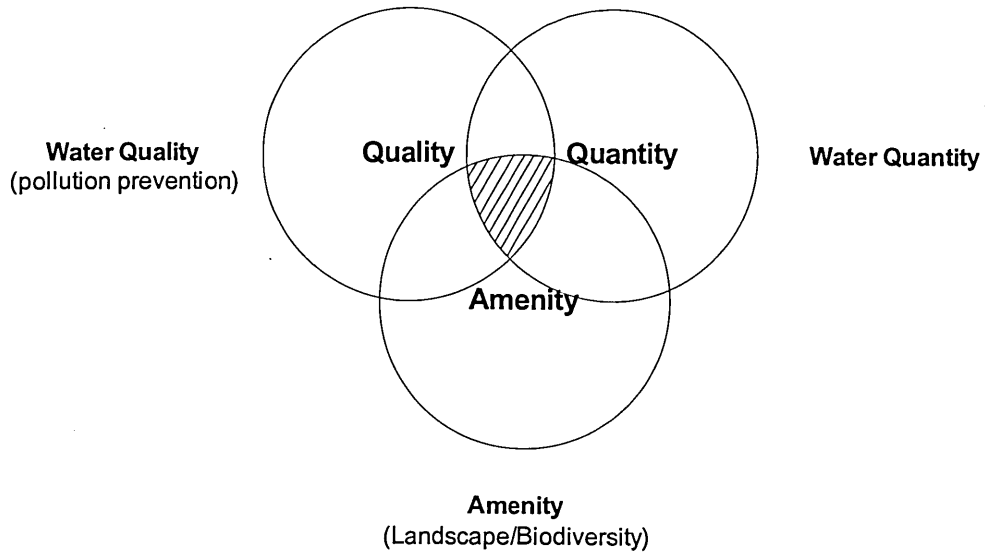

Figure 2-2 SUDS three-ring model- Conceptual overlaps between quality, quantity, and amenity

SUDS, previously named BMPs, were initially designed and constructed to treat urban runoff in the USA where there is wide and increasing use of these systems, some states having adopted BMPs as a common practice for runoff management. SUDS were soon introduced to other countries facing similar problems with water runoff. Examples of countries where these systems are widely applied are Britain, Switzerland, Sweden, Germany, France, Japan, Australia, and South Africa (Campbell, 2000; Krejci et al).

Runoff management techniques that utilise SUDS include issues such as:

1. Good Housekeeping: This mainly refers to practises aimed at reducing at source the risk of chemicals and pollutants in runoff. A major main issues in good housekeeping is public participation. Removal of litter, separation at source, recycling, proper storage of chemical pollutants, and the correct connection of foul water to sewers are some of the issues surrounding good housekeeping. Public information and educational programmes are essential for good housekeeping.

2. Source Control: This refers to structures which attenuate runoff in small catchments up to approximately 5 acres. It includes gravelled parking areas, porous pavements, infiltration trenches, filter strips, swales. These constructions are located as close to the pollutants' source as possible in order to control the quality and quantity of runoff ending up in larger facilities or the receiving water body.

3. Site Controls: These serve larger catchments of 2-5 hectares on any type of development (industrial or residential). They mainly consist of swales, extended detention basins &

attenuation basins, filter drains, and infiltration trenches and are normally larger than the source controls previously described.

4. Regional Controls: These systems serve areas greater than 10 hectares, and they include structures such as extended detention basins, retention basins and wetlands. They remove suspended solids and attenuate flow. Retention ponds and wetlands additionally provide biological treatment (based on natural aeration) and nutrient removal. (Campbell, 2000; Jefferies, 1999).

Deterrents for the acceptance of new systems are:

- Capital cost;
- Cost of maintenance;
- The difficulty of replacing an existing traditional drainage with a new system;
- Lack of awareness among consultants, developers, and water authorities, regarding the effectiveness of SUDS;
- Lack of public awareness and acceptability of the new systems.

The basic criteria for application of these systems in industrial or commercial developments are the environmental and financial benefits while public opinion plays a major role in housing developments.

SUDS consist of different types structures and operational practices, each with their own specifications as briefly described below:

Detention (dry) Ponds. Detention ponds are storage facilities without permanent water, designed to store storm water during high peak flow events. They are used for the removal of suspended solids, and do not provide biological treatment. The outlet should be designed to drain the volume from the basin either over 24 hours or in 12 hours when pre-treatment is required in commercial or industrial areas. The pond also has an emergency overflow for safety during large storm events. Semi annual inspections for plant control, repair of eroded areas, inlet and outlet repairs are recommended.

Retention (wet) Ponds. Retention Ponds are storage facilities, retaining permanent water. They are used whenever biodegradable pollutants are present. They consist of a permanent pool of

water, which should be designed with a detention storage above the permanent pool for peak flow control of a maximum depth of two metres, and a shallow zone for use as a biological filter (Novotny. & Olem., 1994). The pond should provide 21days retention time for biochemical treatment of runoff. According to Urbonas & Stahre (1983), a 50% reduction in phosphorous rates is only achieved when the pond is followed by water filtration. The average pool depth should typically be 1.3-2.0 metres, with 3.0 metres depth being the maximum recommended. Vegetation should cover 25% - 50% of the pond surface area. Maintenance inspections for monitoring aquatic growth, shore erosion, inlet and outlet performance should be carried out frequently especially during the first year of operation.

Wetlands. Wetlands used as SUDS are separated into natural and artificial structures. They also act as storage facilities with permanent water for the treatment of dissolved biodegradable pollutants. They cover a wider area than ponds and look more like natural wetlands. Their size varies, some being several square kilometres in area. Water depth also varies throughout the year. The average depth is 0.5-0.75m. Vegetation (hydrophytes) which is rich in flora providing valuable wildlife habitats should cover about 75% of the surface area. Another characteristic of wetlands is the 'active' growing season, when maximum pollutant reduction occurs. For northern climatic conditions, this period is between May and September (Novotny. & Olem., 1994). Maintenance, important for keeping performance at an optimum level, includes inspections for erosion, for inlet and outlet blockage and for vegetation control by a wetland ecologist.

Swales. Swales are grassed, man-made channels with limited water storage and are a very cost efficient and effective means of water conveyance. They are used for areas of less than 10 acres. Swales have the ability to reduce the speed of runoff so they can control high rates of runoff. They also reduce the amount of runoff through infiltration into the soil, accelerated by the presence of grass. The water depth should not exceed 0.1m. On average, swales have the ability to remove approximately 30% of pollution. The vegetation used is normally grass which also offers side erosion protection. Inspections for erosion control, odour control by channel cleaning, and litter and sediment removal to avoid blockage and malfunction must take place at least semi-annually. Correctly maintained swales have a long lifespan.

Porous Pavement. Porous pavements are high porosity man made pavements with a large underground storage capacity. They can be constructed either in asphalt or concrete. The runoff is drained down the irregularly shaped rock pavement and led to underground pipes or to the

underlying subsoil, while the sides and the bottom of the pavement are covered with filter fabric to avoid mixing runoff with soil. Porous pavements principally find applications in car parks and paved park areas and sometimes for roads, mainly pedestrian or light traffic roads. Porous pavements provide erosion control by reducing the speed of runoff, pollution reduction and groundwater recharge. Their main disadvantages are that they may cause groundwater pollution, are easy to clog and can have high maintenance costs. Maintenance is an important issue with vacuum cleaning being an advisable maintenance solution.

Infiltration Trenches. Infiltration trenches are shallow ditches, 1 to 4 metres deep, filled with gravel, stone aggregate, or sand. They allow infiltration of water and underground storage or conveyance to underground pipes. Infiltration trenches are used for 5 acres maximum surface area; and cannot operate properly in soils with high clay content or in hardened soils with low water absorption. They provide pollutant reduction, runoff attenuation for small sites, and groundwater recharge. They have a short lifespan, relatively high capital and maintenance cost, and may be liable to clogging and the cause of groundwater pollution. The maintenance requirements for ensuring proper operation are high. Monitoring of the trench should occur at least once per year or after every large storm event and should include removal of debris and vegetation control.

Technical information on SUDS can be found in CIRIA (2000), the CIRIA website, and on the EPA website.

2.6.4 River naturalisation/restoration as a sustainable practice

The trend and demand for river restoration has constantly grown over the past decades, especially in urban environments, where river culverting or channelisation has been identified as a reason for environmental degradation. River channelisation is considered by many to be responsible for the loss of natural habitats, to increase the risk of flooding and deteriorate the aesthetics of surrounding areas. In contrast, river restoration with landscaping of the surrounding area is becoming increasingly popular not only in rural but also in densely populated urban areas.

Lately, there is has been a tendency to move from the river channel and sewage treatment into river and watershed restoration (Lant, 1999). This new tendency signifies the turn from a science and engineering based approach to the development of knowledge that is able to support

natural systems. It includes the return of the river to its natural form, with removal of concreter, improvement to river hydraulics, and landscaping of river banks and surrounding areas. This new approach is based on the integration and analysis of the important technical elements for river naturalisation, such as geomorphological attributes, ecological and engineering factors, while taking into account social and economic issues (Wade et al., 2002). This new model in river planning encompasses the ideas incorporated in the context of sustainability and prioritises the community benefit.

The social dynamics of river naturalisation, although poorly investigated, are of great interest to researchers and engineers. However, there is a strong indication that integration of scientific expertise and public involvement in decision making regarding river restoration is a critical issue (Brookes & Shields, 1996). Understanding the mechanisms that influence public attitudes towards river naturalisation is crucial for the implementation of such projects and this has been one of the motives for undertaking the 'comparative study' element of this research programme.

The incentives for adopting river restoration as a 'sustainable' way of dealing with water bodies can be traced back to the ideas of 'romanticism' and the 'garden city movement' and the growing appreciation for amenity landscapes. Continuing ecological degradation and the need to improve the urban environment for a number of reasons, ecological, cultural, social and psychological, and the promotion of development that encompasses the idea of sustainability, have all contributed towards this change in direction. Open rivers within urban environments provide amenity features of high recreational value. Research has shown that people are keener to visit riverbanks of urban streams than to visit hills or other amenities within urban settings (Lopez & Munoz, 2003).

The ecological rehabilitation of modern cities has now been prioritised and there is a clear shift towards ensuring quality of life, which encompasses the ideas of quality of the environment, well being, and identity. The first step in this process is the improvement of the quality of the built environment at a neighbourhood scale to satisfy the needs of society and individuals (Lopez & Munoz, 2003). Children tend to use rivers most. The use of outdoor space has dramatically changed in modern cities and outdoor activities have been replaced by indoor activities due to parental concerns over safety and the absence of green open spaces. It is children who welcome and make the most use of rivers within urban settings. Research has demonstrated that children find rivers fascinating and appreciation of the amenity and biodiversity value of the rivers is learned through playing (Tapsell et al., 2001).

A man-made environment with a heavily modified river is meaningful only when it expresses the structure and meaning of the natural world (Norberg-Schulz, 1979). It is very important that a river restoration scheme should try to preserve the "natural identity" of a river, such as the special and essential characteristics of the river offered by its morphology, vegetation and hydrology (McHarg, 1969). The preservation of the natural identity of a river, which is synonymous with the preservation and improvement of the natural environment and its characteristics, is vital for strengthening the urban identity of the specific place.

2.7 PUBLIC PARTICIPATION AND EDUCATION

2.7.1 Public participation for environmental conservation and planning

Public participation has been identified as a key principle in water management. It can be defined as the systematic process which allows people to influence the outcome of plans, processes and policy mechanisms. Public participation is seen as the means through which people become better informed, participate in decision making, and become more willing to accept change. Public participation promotes social learning, more open and integrated government, democracy in water management, more effective implementation of water policies and sustainable water management.

The political ideology of participation in urban planning and ecology is based on the fact that it seeks to persuade people of the intrinsic value of the natural world, and of the duty of care for nature not simply because this is beneficial to humankind, but because it is to the benefit of nature as a whole (Fox, 1984). Public participation in the planning system in Britain was instituted by the Town and Country Planning Act of 1947, which requires planning authorities to inform and consult the public (Taylor, 1998). Public involvement in decision-making is vital in urban landscape design (Blowers, 1993). It is also essential to progress the increasing number of local initiatives aimed at establishing a balance between the built and the natural environment and at achieving sustainability goals,.

However, the idea of public participation in environmental conservation and urban planning is not a new concept. In the 19th century, following the pressures that the industrial revolution had on the environment, conservation movements which were popular amongst middle class citizens started to emerge in Europe. Nineteenth century citizens of several European nations formed

voluntary groups to protect wildlife and preserve natural areas of national or biodiversity importance.

In Britain the conservation movement was started in 1867 with the formation of a society for the protection of seabirds nesting on the Yorkshire coast. The wildlife campaign, became recognised with the help of 'The Times' of London and the 'Royal Ornithological Union', and succeeded in introducing a parliamentary bill protecting seabirds, passed in 1869 (Sheail, 1976; Lowe 1983). At the same time, the Society for the Protection of Birds was founded in Britain, initially as a women-only conservation group, opposed to the use of the feathers of exotic species in clothes. Soon the movement spread throughout Britain numbering about 9000 people and was renamed the Royal Society for the Protection of Birds, still one of the leading environmental conservation groups in the country. In 1868, in Germany, farmers and foresters pressed the Austro-Hungarian foreign office to protect a species of migratory birds, which was considered beneficial to German agriculture. In 1902 a list of 'beneficial' birds to be protected was agreed and signed by all countries involved. In 1904, the social elite of Amsterdam formed a citizens' group to protect a bird breeding area in the Naarder Sea, east of Amsterdam, from the dumping of city refuse. The group soon purchased the threatened land and converted it into a nature reserve (Dalton, 1994).

In post-war Great Britain, the idea of public participation as an important component of urban planning was introduced through the Town and Country Planning Act of 1947. A second wave of environmental action in Europe started in the late 1960s when greening became a major political topic. Public interest in conservation and environmental protection increased, and new environmental groups emerged. New political activists with special interest in environmental issues emerged through the student movement of the era, the main focus being on matters related to conservation and to environmental protection from the 'newly' emerging problems of acid rain, nuclear power and climate change. It seems that the post-war children of Europe provided the basis for a modern environmentalism. To further stimulate public involvement in environmental conservation, the Council of Europe declared the year 1970 as 'European Conservation Year', while a United Nations Conference on the Human Environment was held in Stockholm in 1972, where 114 nations and a large number of experts, such as conservationists and environmentalists participated (Nicholson, 1970; Caldwell, 1984).

At the same time environmental protection groups, such as Friends of the Earth, Earth First, and Greenpeace spread around the developed world. Friends of the Earth illustrated a new model of

public involvement in decision making by highlighting surface sensitive issues to governments and challenged the social paradigm of industrial societies (Yearly, 1991).

Earth First was founded in the 1979 as a reaction to environmental degradation. The biocentric worldview, adopted by Earth First activists who oppose the anthropocentric view of civilization, encompasses the concept of wilderness and biodiversity preservation (Foreman & Haywood, 1993; Abbey & Foreman, 1987; Anon, 2004).

Greenpeace, the international network of ecology groups, was formed in the early 1970s to protest a planned nuclear test by the U.S.A. on the Aleutian island of Amchitka (Hunter, 1979; Brown & May, 1989). This protest united both environmentalists (green) and opponents to nuclear weapons (peace), forming the name and the campaign framework of the organisation. Since then Greenpeace has become one of the leading ecology groups, actively involving the public in the fight against environmental destruction and war (Yearly, 1991).

Environmentally orientated political groups are now active in most countries, and green thinking often influences political action, as in the case of Rudolph Bahro who, holding deep-ecological ideas, left the German Green Party in June 1985 due to his uncompromising opposition to animal experimentation. Green political thinking has resulted in new environmental policies and legislation within the European Community. The European Community issued the Fourth Environmental Action Plan in 1986, and modified the Treaty of Rome through the Single European Act of 1987.

When the influence of Thatcherism passed in the 1990s there was a clear trend to engage several social groups in the planning process, with special emphasis on bringing together a range of stakeholders involved in planning. However, this attitude bears the danger of limiting public participation to professional organisations, such as local authorities, developers, government agencies and national environmental groups, excluding the immediate participation of the local residents. Another constraint was shift towards an audit culture in the 1990s, which requires public bodies to demonstrate that they have acted with probity (Rydin, 1999).

However, in the 1990s many citizen groups formed to oppose or protest ideas and plans that were perceived to affect their standard of living and deteriorate the urban environment, one of the most prominent examples being the anti-roads protest movement in Britain. The anti-roads movement brought together environmental activists with local residents in an effort to oppose new road works, which could negatively impact on the lives of residents. The leading activist

group 'Alarm UK' formed in response to the road building programme announced by the British government in 1989,. Its main function was to provide a support network to local campaigns against the massive road works and in support of the development of sustainable transport alternatives (McNeish in Seel et al, 2000).

During the last few decades, there has been a remarkable effort to combine environmental and 'democratic' considerations in the planning process. Decision-makers, stakeholders and the public affected by or impacting on environmental conditions recognised that traditional decision-making merely involving policy makers, is insufficient. In addition, decisions taken through the traditional approach often lack popular acceptance and many are doomed to failure because they do not take into account local knowledge and public needs (Renn et al., 1996).

In a similar vein, changes in the Environmental Impact Assessment (EIA) process were an effort to improve public participation, although it is argued that the concept of public participation has underpinned EIA since its inception (Petts, 1999). Although the ambition of decision-makers and legislators has been to address local concerns and knowledge by increased citizen involvement, this process often fails due to lack of experience and knowledge on how to approach and involve local citizens and use their ideas in constructive ways (Dresner & Gilbert, 1999). The successful implementation of regional sustainable development strategies is now widely understood to depend on the recognition of differing situations, local needs and development aspirations, which are emphasised through public involvement activities. In support of local involvement activities towards achieving the goals of sustainable development the European Union proposed a system of indicators relevant to communities under the title 'Towards a local sustainability profile—European common indicators' (European Communities, 2000).

More recently, public participation in local decision-making has been part of the social system in developed countries. In the UK, Local Agenda 21 initiatives, led by regional bodies and local councils have empowered public participation. Moreover, sustainable development and community participation in planning have been strengthened by the advent of community planning, a statutory duty placed on local authorities (Local Government Association, 1998; Easton, 2001). In addition, the UK government published local indicators to be used by local authorities as basic guidance for establishing their own 'locally applicable' indicators (Department of the Environment, Transport and the Regions, 1999, 2000).

However, there is a wide debate on the limitations of the concept of public involvement in planning. Although public participation is the act of the sharing information in formulating policies and strategies, a question of 'democracy' in planning arises. The dilemma is that, although democratic participation involves public engagement in decision making, it is still the planning authorities which have responsibility for the planning process. Skeffington argues that the main limitation to public participation is that planning implementation is, and should be, left in the hands of the experts. Based on this, Skeffington acknowledged that to democratise the model of public engagement meant to improve communication, understanding, and consultation between planners and the public (Taylor, 1998). This 'technocratic perspective' suggests that planning decisions should be made on the basis of 'best science' and left in the hands of the experts. On the other hand the 'democratic perspective' suggests that the public should have the knowledge and the right to influence decisions, and often question or test the technical experts, especially when public safety and well-being are affected (Irwin & Michael, 2003).

The 'democratic' approach to public participation involves public understanding of planning issues and the understanding of science. The 'deficit model' implies that public education is essential for acquiring scientific knowledge, in order to support public participation procedures in decision making, and it suggests that greater public knowledge of scientific matters leads to more positive attitudes. Although there is evidence in support of this argument, there is always the danger that the deliberate increase of scientific knowledge of the public will lead to increased awareness of the uncertainties involved with the specific scientific matter (Irwin & Michael, 2003).

The European Commission responded to this debate over 'top-down' and 'bottom-up' approaches by producing its Action Plan on Science and Society, which set up a framework for change in the relationship between science and society, suggesting a mixture of 'technocracy' and 'democracy'. It supports the 'democratic' approach by proposing 'open dialogue' between the public and scientists over new technologies, and emphasising public inclusion in decision making, while at the same time suggesting a retreat to a technocratic top-down approach and setting guidelines for the use of experts (European Commission, 2002 in Irwin & Michael, 2003).

The White Paper (1993) 'Realising our Potential' states that *"The understanding and application of science are fundamental to the fortunes of modern nations. Science, technology*

and engineering are intimately linked with progress across the whole range of human endeavour: educational, intellectual, medical, environmental, social, economic and cultural".

The UK response to the challenge of public understanding of science is outlined in the 'House of Lords Report on Science and Technology'. This Report formed recommendations on ways of improving the dialogue between the two sides through:

- support of "public understanding of science" and of the impact of science activities;
- improved communication of uncertainty and risk;
- changing the culture of policy-making and bring together science and the public and involving the public in dialogue at an early stage of a development.

The new culture suggested by the House of Lords Report focuses on creating a new 'mood' for dialogue ultimately aimed at actively engaging the public (House of Lords Report, 2000).

The key messages of the House of Lords Report of interest to the current research work, as summarised in Irwin & Michael, outline the need:

- to create a new culture of dialogue between scientists and the public;
- to pay attention to public values and attitudes;
- for all advisory and decision making bodies to adopt policies in their approach to their work which are open and transparent to the public;
- for scientists and the media to work constructively with each other.

(Irwin & Michael, 2003)

2.7.2 The legislative framework of public participation

Nowadays, many people appear to be interested in environmental matters, especially issues of environmental quality, energy options, and the protection of nature. The environmental movement includes all those individuals who defend environmental justice, which revolves around the notion that everyone has the right to live and grow in a healthy environment. Although most of these individuals have no professional expertise in environmental protection,

their views are of great value to large environmental organisations as well as smaller green groups and citizen action groups. Local groups have often helped to develop initial public awareness of environmental problems and mobilise participation in environmental actions.

Green ideas are gaining ground within the international political landscape. Environmental activists are critical towards today's consumer–driven society. Conservationists are worried about the destruction of the environment and the ecosphere in general, and citizen groups are becoming increasingly active in issues of conservation and environmental protection. Matters such as acid rain, ozone layer depletion, global warming, pollution, and species conservation are now issues of major public concern. The political systems of most of the Western democracies have become dominated by environmental movements either in the form of citizen groups or even political parties.

Examples of international treaties and legislation, in which public involvement is included as a central issue are presented in Table 2-1.

Table 2-1 International conventions

Stockholm Declaration on the Human Environment, 1972
Recognition of the need for governmental and public cooperation towards environmental protection
Brundtland Commission, 1987
Definition of the term "sustainable development" to include the environmental, economic, social dimensions.
Rio Declaration on Sustainable Development, 1992
Achievement of the goals of sustainable development through encouragement of public participation
Aarhus Convention, 1998
Environmental justice to be achieved through public participation in decision-making
UN Millennium Declaration, 2000
Millennium goals to include social equity and public involvement in problem solving
Water Framework Directive, 2000
Public participation as a basic requirement in river basin management
Johannesburg Declaration on Sustainable Development, 2002
Public participation and involvement in decision-making becomes a prerequisite of sustainable development on global scale

(UNEP, 1972; Brundtland Report, 1987; UNEP, 1992; UNECE, 1998; UN Millennium Development Goals, 2000; EU Directive2000/60/EC/WFD, UNEP, 2002)

During the past 30 years this need for public participation and stakeholder involvement has been widely accepted, and is prominent in recent international agreements, declarations, conventions and legislation. In other words citizen empowerment includes partnerships that enable the public to negotiate and engage in trade-offs with traditional power holders. It also implies delegated power, and citizen control, through which the citizens participate in decision-making or hold full managerial power (White, 1996).

Compliance with current legislation is aimed at achieving compliance between environmental risks and economical benefits in accordance with the principles of:

- Democracy;
- Sustainability;

Legal requirements (e.g. EU directives):

- Provide information;
- Identify issues;
- Discuss solutions;
- Influence decisions;
- Clarification of misunderstandings;
- Creation of credible decision making;
- Reduction of costs.

Principle 15 of the Rio Declaration emphasises the need for individuals of any societal level to be involved in and committed to achieving the goal of sustainable development in the twenty first century (UNCED, 1992). More detailed reference and emphasis on the same issue is given in section III of Agenda 21, where there is a call for local authorities, as the governance structure closest to the public, to be active in educating the public. In that sense local authorities should be engaged in a dialogue with citizens, enterprises, local businesses and industry to acquire the necessary information to help in the process of consultation and raise awareness of sustainable development issues.

To meet the goals of Agenda 21, public participation should be inclusive, be considered as a learning process and consensus building should be a goal. It is obvious that local residents have strong opinions on local landscape issues. Additionally, green policies reflect public attitudes and are becoming increasingly acceptable among stakeholders. Therefore, it is very important to assess the perception of residents on environmental issues as part of the planning process. The Brundtland Report (1987) is also clear that the idea of sustainable development includes community empowerment. Similarly, 'think global, act local' which was introduced in Local Agenda 21 is adopted by many environmentalists and can be considered as a further underlying principle behind the empowerment of the idea of public participation (Jordan & Maloney, 1997).

The Water Framework Directive (WFD), Directive 2000/60/EC, which is aimed at establishing a framework for European Community action in the field of water policy, requires inland surface waters, transitional waters, coastal waters and groundwater to reach 'good status' by 2015, through stakeholder involvement. Stakeholder involvement in this context targets the establishment of a river basin district structure within which strict environmental objectives will be set and met. The WFD uses the term 'public information and consultation' instead of 'public participation' which is a fairly modest ambition.

In the WFD the first level of real participation is consultation which includes the idea that people as well as stakeholders can react to plans and proposals. Consultation is used at an early stage of each water management plan to gather information, knowledge, perceptions, experiences and ideas from the parties involved and aims at developing solutions and assisting decision-making. On the other hand, active involvement is a higher level of participation in the development and implementation of water management plans. The interested parties, public and stakeholders, actively participate in the planning process by discussing issues and contributing to the solution process. The interested parties can also participate in the planning and in the decision-making process with a higher level of involvement and consequently bear partial responsibility for the outcome.

Preamble 14[5] of the WFD refers to the fact that public participation will contribute to the overall success of the Directive, while Preambles 46[6] emphasises the importance of informing the

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5 Preamble 14

general public in order to facilitate their participation in the planning process. All references to public participation in the WFD are attached as Annex I.

The Common Implementation Strategy (CIS) - Guidance on public participation in relation to the WFD, also recommends that engaging stakeholders at an early stage of water related projects helps to:

- Share experience;
- Develop best practice;
- Provide support and advice to those potentially affected by the Directive;
- Deliver a targeted approach to public participation.

Article 14[7] of the Directive specifies that member states should encourage the active involvement of all stakeholders in the implementation of the Directive and in the development of river basin management plans. At the same time they have to ensure consultation and access to background information. The three forms of stakeholder engagement, as prescribed in Article 14 of the WFD, are:

The success of this Directive relies on close cooperation and coherent action at Community, Member State and local level as well as on information, consultation and involvement of the public, including users.

6 **Preambles 46**

To ensure the participation of the general public including users of water in the establishment and updating of river basin management plans, it is necessary to provide proper information of planned measures and to report on progress with their implementation with a view to the involvement of the general public before final decisions on the necessary measures are adopted.

7 **Article 14**

1. Member States shall encourage the active involvement of all interested parties in the implementation of this Directive, in particular in the production, review and updating of the river basin management plans. Member States shall ensure that, for each river basin district, they publish and make available for comments to the public, including users:

(a) a timetable and work programme for the production of the plan, including a statement of the consultation measures to be taken, at least three years before the beginning of the period to which the plan refers;

(b) an interim overview of the significant water management issues identified in the river basin, at least two years before the beginning of the period to which the plan refers;

(c) draft copies of the river basin management plan, at least one year before the beginning of the period to which the plan refers.

On request, access shall be given to background documents and information used for the development of the draft river basin management plan.

2. Member States shall allow at least six months to comment in writing on those documents in order to allow active involvement and consultation.

3. Paragraphs 1 and 2 shall apply equally to updated river basin management plans.

1. Consultation within the planning process.

   Consultation aims at learning from comments, perceptions, experiences and ideas of stakeholders. Consultation is a non-intensive form of public participation, applicable at an early stage of the participatory process. Yet, whereas active involvement is often necessarily somewhat selective, consultation allows all interested parties to become involved in decision-making. Consultation is a useful complement to active involvement and can function as a kind of check on active involvement to see if all interests and points of views were represented.

2. Active Involvement in the planning and implementation of water management strategies.

   Although "active involvement" is not defined in the directive, it implies that stakeholders are invited to contribute actively to the process and thus play an advisory role within the framework of water related projects.

   The ideal of active involvement is inclusiveness but, in practice, the notion of involvement of everyone who has a stake, usually needs to be qualified 'as appropriate' to the context of the particular water management plan due to constraints such as timescale, technical complexity and requirements. Understanding, establishing and communicating clear boundaries for active involvement in the strategy will help keep stakeholder expectations realistic.

3. Access to background information, which covers two aspects:

   - Sufficient information supply in the different implementation steps
   - Access to background documents and information according to Article 14

   Sufficient information is needed throughout the whole implementation process to enable active involvement of stakeholders and the public based on the specific requirement of Article 14 (1):"on request, access shall be given to background documents and information used for the development of the draft river basin management plan". Providing stakeholders with improved access to information and decision-making will also oblige them to take shared responsibility for utilising their networks and communication channels.

   The access to background materials and information must be provided in the conext of the Environmental Information Directive and the Aarhus Convention. The Aarhus

Convention brought about an amendment to the Environmental Information Directive (Directive 90/313/EC) and national laws had to be harmonised with this amendment by the end of 2006. The information and materials referred to in the framework of Article 14 (1) are all environmental information within the meaning of the Information Directive (both definitions are extensive in scope and also include, for example, measures that could have an impact on environmental media).

The concept of public participation and its role in planning can be summarised as the process through which:

- Social consensus is utilised in an effort to mitigate conflicts;
- Decision-making becomes more transparent and legitimate;
- Adverse environmental consequences of decisions-making are prevented;
- Solutions and opinion to solving problem are generated.

The rhetoric of participation has undermined and overlooked many dimensions of participation itself. Although all those who use public participation may agree that it is a democratic, desirable and necessary practice, one must look into the actual content of who participates, the level and the form of participation, and the interests of the participating individuals. In this way one can succeed in minimizing the potential drawbacks of public participation which are:

- The belief that experts are superior decision-makers because of their knowledge, skills and qualifications. Lack of public knowledge runs the risk of establishing a 'dictatorship of the uninformed';
- The public may be less accountable for the decisions made, it is easy to plead ignorance;
- The public may not want to undertake the responsibility or the time commitment;
- The participating parties tend to be among the more privileged groups, able and willing to invest more time and influence;
- Public participation can result in the creation of local hierarchies, dominated by professionals and bureaucrats thereby, reproducing and re-entrenching power relations.

Public participation in water resources management, is promoting consensus building, conflict management, and dispute resolution. In addition, public participation in water resources management aims to:

- Help to meet the ethical dimensions of water management;
- Meet legal or formal policy requirements;
- Link water management with civic culture;
- Help to manage the tension between the technical and political scene;
- Help to reconcile the discontinuities between geographic and jurisdictional boundaries;
- Find and build common ground between the involved parties, stakeholders, and a move from extremes;
- Improve consensus building and conflict management;
- Reach sustainable or durable agreements.

There is a common realisation that the policy world of the water management sector not only includes policy-makers but also scientists and organised associations and individuals. The interactions between them are well depicted in Figure 2-3.

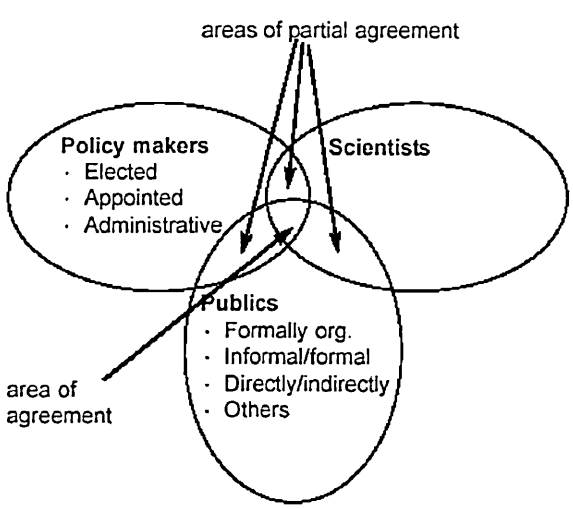


Figure 2-3 Participation and consensus building in water management (White, 1996)

The involvement of local people as an integral part of the planning system, in combination with the expert knowledge of planners and stakeholders, is essential to meet the concept of sustainable development. Above all, this requires sustained effort to inform the public about environmental issues and promote public involvement. The ultimate target is to influence political perception and agendas towards sustainable construction in urban areas with special emphasis on the ecological, financial, and societal benefits. However, the most crucial part of public involvement is to raise public awareness and change normal behaviour. The promotion of alternatives practices and processes to those which traditionally abuse the natural world, is central in influencing public attitudes. Improvement of land-use and creation of amenity landscapes will not occur unless there is an understanding of the relationship between man and his environment (Rookwood in Blowers, 1993).

2.7.3 Public education in support of public participation

Before convincing the public to participate in urban planning and become actively involved in intervening in landscape design, often through the application of educational campaigns, special focus should be drawn to developing an understanding of public perceptions and expectations. Research has indicated that there is deviation between the public perception of watershed issues and the actual problems of the local catchment. Most individuals are unaware of the concept of a catchment and the hydrologic connection between their house, their actions and the local watercourse. For example, studies carried out in the USA have demonstrated low levels of awareness of the impact of the use of fertilisers and pesticides as well as actions which contribute to the degradation of watershed quality such as car washing, domestic washing, fluid changing and septic system maintenance (Feature Article – 2, 2000). In consequence, it becomes obvious that planners should be aware of the ways of communicating their own knowledge and understanding of environmental issues without increasing public anxieties. At the same time it should be clearly understood that all development has to occur within the legal system of each country and the ultimate decision-making is strictly a task of the elected representatives (Anderson & Meaton in Miller & de Roo, 2000).

Education is the key to managing perceptions aiming at convincing locals to contribute to the creation of their local landscape. The educator should send a clear message to a public constantly bombarded by competing messages from stakeholders and mass media. A complete environmental education programme should involve three different approaches:

- Education about the environment (provision of relevant information);
- Education through the environment (using the environment itself as the means to enhance knowledge);
- Education for the environment (developing awareness and concern over environmental issues).

Since education strategies are addressed to people of any age and background, the three aforementioned approaches should be used in combination to achieve the desired outcome (Rohde, & Kendle, 1997). However, in cases where the public have demonstrated high levels of awareness on certain environmental issues in their local area, a more sophisticated and action-oriented message should be sent to stimulate a change in environmental behaviour (O'Keefe and Shepard, 1999; Nowak et al., 1997 in Shepard, 2000).

Public participation in planning, should also involve activities such as participation in meetings where both stakeholders and public bodies are represented. The issue of specific interest should be high on the agenda and constructive ideas should be expressed and members of the public should participate in voluntary activities related to the project. It is important participation of the public in the relevant activities should be consistent and there should be mutual respect and appreciation between the participants and of their contribution to the project (Anon., 2003). Although, public involvement is vital for the success of urban watershed restoration projects, it is not an easy task. The public perception and participation project on the Rouge River Watershed in metropolitan Detroit showed that, along with issues highlighted by the current research programme, the best way to inform the public is through the use of informative leaflets or community newsletters. In the United States, public, non-profit organisations and agencies with responsibility and/or interest in health and the environment are the most suitable for the provision of information on watershed issues (Powell, 2000).

However, there are a few main problems the educator has to overcome in communicating with, and educating the public:

- To pass on the scientific knowledge to the public in the most simple and understandable way. Although this sounds obvious it is not always an easy task. The planners' views and the language they often use are not widely understood by the public. The use of advanced terminology and 'sophisticated campaigns' are not recommended. Mass media

seems to be the most influential means of public education, and the cheapest per head. While a lot of effort is required for an informative campaign using leaflets, consultation and guidelines, mass media campaigns can educate a larger number of people more effectively;

- The difficulty in overcoming differences in perception of an environmental problem and to change public attitudes. According to a series of surveys on watershed perceptions, carried out in the U.S., the majority of residents cannot associate their every day activities with the watershed. They do not know about or understand the hydrologic connection between runoff and the natural watercourse (Feature Article - 2, 2000). Educators often tend to believe that the public have similar understandings of certain issues and they do not always consider it necessary to evaluate public perception before starting the educational process;

- To deal with strong attitudes among the public on the subject of their interest (which are not always positive) due to previous negative experience based on inadequate public education by other planners or authorities;

- Economic constraints. The limited budget available for environmentally related educational programmes.

(Luz, 2000 & Feature Article, 2000)

Regardless of the difficulties the educator has to overcome, the benefits of educational campaigning are obvious, especially prior to the application of new methods and technologies such as SUD ponds or river management schemes. This research programme and other similar research (Howe & White, 2002; Hjerpe & Krantz, 2000) shows that a well informed public that is consulted prior to the implementation of new schemes tends to be more positive towards the benefits of the systems. The less tangible benefits such as improved biodiversity and amenity are also better appreciated.

2.8 DISCUSSION

Perceptions of nature and water bodies have always been prominent in the philosophical and scientific ideas of each era. The concept of sustainability, in combination with the latest ideas of environmental conservation which have been based on the development of environmental

thinking through time has boosted the formation of environmental ideologies and environmental sociological movements.

For environmentalists, 'sustainability' is the means by which future humanity will live in of balance and harmony with the natural world. Those who press for sustainable development consider the move towards protection of nature to be achievable through the spread of non-degrading forms of agriculture and industry. Preservationists and ecologists want to save pristine nature as wildernesses before it can be destroyed by development. Social ecologists and 'green parties' devise new economic and political structures to overcome the domination of human beings and non-human nature.

Although nature has been transformed and abused due to natural selection processes and human interventions, it has never been far from forming part of people's values and understanding of their surrounding environment. Amongst other issues, environmentalism has emphasised the importance of natural places in our lives; *"we are not mere products of our culture and society. We are also the products of the various places and contexts that we depend on"* (McGinnis in Smith, 2001).

Theories on the environment and ethics play a crucial role in formulating morality and in influencing the formation of ethical aspects of culture. Today, ecologists seek to re-establish our ethical relationships with the natural world, raise awareness and strengthen feelings of respect towards natural places and non-human beings. Thus environmentalism of today reminds culture of its origins, and of the need to maintain an ethical relationship with nature to preserve society (Smith, 2001). The most critical ecological movements are based on the need for re-establishing this ethical relationship and contact with nature in an effort to protect the natural environment, and to strengthen collective rights to common resources.

Post-modern ideas on the environment which have gradually emerged, through environmental philosophy and society's sensitisation on environmental issues, has clearly influenced public thinking nowadays. The move towards whatever resembles the natural world has formed attitudes and perceptions of how the urban environment should be if it is to be considered sustainable. This turn towards nature, as well as the impacts of environmentalism upon contemporary thinking, is depicted in modern architecture and urban landscaping. Urban landscaping has moved from concrete to sustainable, construction which mimics nature and often incorporates water features. New urban landscape ideas focus on the construction of green areas and water bodies in the form of ponds and wetlands situated within residential areas.

These resemble natural features and help to re-establishes the lost contact of modern men with nature. This new architectural approach has been influenced by environmental ideas and is along the lines of sustainable development.

The construction of open urban spaces can be considered to be the same as a move towards whatever is natural and pristine. Urban parks and watercourses are multifunctional and serve the conceptual, cultural, ecological, social, and psychological needs of the modern urban citizen leading to the understanding of the need for sustainable construction such as SUDS and river restoration, which promote the presence of water bodies and open green spaces in urban areas, and are in agreement with ideas of conservation of nature and biodiversity.

In addition, the importance of public involvement in the planning of green open spaces which include water features, and the influence of public education in formulating attitudes and in increasing acceptability of novel approaches is nowadays recognised by the engineers, landscape architects and planners who design and build the new systems.

The different themes in literature and the encompassing ideas presented in this chapter were used to guide the formulation of the questionnaire/interview themes of this research programme. The questionnaires included sections addressing those issues identified in the literature as being relevant to this programme. Consequently, the concepts of environmental awareness, amenity, biodiversity, landscape preferences, sustainability, environmental safety, public awareness and social acceptability were all investigated within the concept of SUDS and river management within urban areas.

Details of the methodology selected for the assessment of the public and professional attitudes of stormwater management systems are presented in the following chapter (Chapter 3).

3 METHODOLOGY

"Common to theory and practice is an aspiration to establish congruity between thought and reality".

— Cohen, 1984

3.1 INTRODUCTION

The aim of this chapter is to present and explain the methodology engaged in each research phase. The methodological approach of the research programme currently presented was carefully chosen to address adequately the issues related to the major aim of the project which was the assessment of the social impacts of different stormwater management practices. The chapter commences with a brief overview of different investigative methods used in social research. The research strategy was decided after examining the different approaches used by social scientists for the assessment of perceptions. The reasons behind the choice of methods, in particular the use of a combination of approaches, are also included in this chapter.

The objectives of this chapter are:

- To outline and justify the choice of the methodological approach used in the research programme;
- To address specific ethical issues pertaining to the current research;
- To explain in detail the methodologies chosen for each research phase separately.

This project included three research phases, each engaging a different investigative approach. During the first research phase the public perception of SUDS in the UK was assessed through quantitative methods which made use of experience gained through previous surveys of public perception of SUDS in Scotland by the author (Apostolaki et al., 2001). The second phase, which involved the assessment of the professional perception of SUDS in the U.K, made use of qualitative investigative methods.

During the third and last phase, a combination of research methods was used to assess public and the professional perceptions of stormwater management methods, such as SUDS and/or river management, in areas of Glasgow, London and Athens. Quantitative assessment of attitudes used public surveys making use of structured questionnaires, and qualitative methods in the form of semi-structured face-to-face interviews. Focus groups with professionals

involved in the design and implementation of stormwater management techniques were also used. The experiences gained during the previous research phases were used as guidance in the selection of the methodology for the third research phase and in the design of questionnaires and interviews.

The reasons behind the choice of the specific investigative methods are presented later in this chapter, while the timescale of the different research phases and the methodologies applied in each is presented in Table 3-1.

Table 3-1 Research phases and Methodological approaches

RESEARCH PHASES	RESEARCH PERIOD	METHODOLOGIES
1. Public Perception of SUDS in the UK	2001 – 2002	**Quantitative Research** Door-to-door questionnaires with open-ended questions addressed to the public
2. Professional Perception of SUDS in the UK	2002 – 2003	**Qualitative Research** Semi-structured interviews applied to professionals
3. Public & Professional Perception of Stormwater Management Techniques in the UK & Greece	2003 – 2004	**Combination of Quantitative & Qualitative Methods**
a. Public Perception of a stormwater management scheme in Glasgow, UK		**Quantitative Methods** – Use of door-to-door questionnaires addressed to members of the public
b. Public Perception of a stormwater management scheme in London, UK		
c. Public and Professional Perception of a stormwater management scheme in Athens, Greece.		**Qualitative Methods** – Use of semi-structured interviews applied to members of the public and professionals

This chapter presents the methodological approach followed during the research programme. It presents an overview of the ethical issues involved in social research, in particular the approach towards ethics which was followed. A general review of the investigative methods used is followed by a more detailed analysis of methodological issues. This assessment takes a case-study approach as it is presented separately for each research phase. Each section presents in detail the methods selected supported by literature, the aims served by the specific investigative method, and its design and structure. Links are established between the methodologies of the different research phases, the themes under investigation and the themes identified in the literature.

3.2 THE APPROACH TO ETHICS IN THE CURRENT WORK

Before analysing the methodological approach of this research programme it is important to refer to the 'ethics' of applying social research, and emphasise the context of the current work on research on attitudes.

During this research programme care had been taken to protect interviewees from an ethical point of view, personal information was not of any interest. Anonymity was strictly protected due to the recent and growing concern over the ethics of scientific research. Ethics, in its classic sense, is the branch of philosophy which is said to have been initiated by Aristotle; it is about practical knowledge and the application of theory to human activities, taking human action as its subject matter (Finnis, 1983).

"Ethics is the science of morality and those who engage in it determine values for the regulation of human behaviour" (Homan, 1991).

The development of a code of ethics for social research must recognise the factors which influence the research. However, the main obstacles in setting guidelines for ethics in social research lie outside the social scientific community, and includes the sponsors of research and the mass media (Warwick & Pettigrew, 1983).

Social research can easily reflect the prejudices of society or of the research community. To avoid this, 'background assumptions', upon which research decisions and analysis are based, should be open to scrutiny (Gouldner, 1971). At the same time the social researcher should not forget that although social research illuminates and reflects what happens in social life, it does not ultimately have any impact upon social behaviour and life. "Life cannot wait for social research to catch up with it" (Shipman, 1971). On the other hand, in an information society, invasion of privacy is a common phenomenon (Poster, 1990; Lyon, 2001) and this underlines the importance of privacy in social research and widens the scope of ethics (Bulmer, 1979).

The key for preserving ethics in social research is to find a balance between respecting the rights of individuals and fulfilling the requirements of social research. Realistic results need to be obtained and social perceptions and trends identified. If social scientists and researchers work towards gaining trust and respect of the society they study they are likely also to gain the trust of the wider community (British Sociological Association, 2002).

According to the Data Protection Act in the UK (1998), the principles for engaging in social research which respect the individual and society include the adoption of research methods that are:

- Fairly and lawfully processed;
- Processed for limited purposes;
- Adequate, relevant and not excessive;
- Accurate;
- Not kept longer than necessary;
- Processed in accordance with the data subject's rights;
- Secure;
- Not transferred to countries without adequate protection.

(www.dataprotection.gov.uk)

The American Association for Public Opinion Research (AAPOR) has also developed a code of professional ethics and practice which sets out the ethical rules and limits of research to protect the public from abuse. This code includes rules aimed at:

- Reassuring the reliability and validity of the results through the selection of the appropriate methods and analysis;
- Providing clarity in informing the participants about the topic of discussion, the aims and the sponsors of the research so they can be asked to provide their consent to be interviewed;
- Preserving the anonymity and confidentiality of the participants, when this is possible or desired (AAPOR, 1996).

The anonymity and confidentiality of the participants were protected in the course of this research since as the participants were not asked any questions which could reveal their identity. The survey topics were related to attitudes on technical issues and not on personal

matters and this assisted the public taking part in the surveys. Even in the case of the postal survey in London where the participants included their name and address in the reply envelope, confidentiality was still preserved and the respondents participation was voluntary. The ethical issue encountered in the case of Athens was related to the opposition faced in carrying out a public door-to-door survey to the areas affected by flooding. The Ministries of Environment, Physical Planning and Public Works expressed opposition to such surveying because of negative attitudes towards the stormwater management plan selected for the Kifisos River. To avoid further opposition which might have led to a public outcry with political implications, it was decided to limit the survey to semi-structured interviews with professionals and members of the public. The method selected did not have the reach of a wide public survey and the number of participants was limited to avoid publicity and strictly preserve confidentiality and anonymity.

Sampling of the participants, also very important in social research, was designed to ensure representative results from the community of interest. Random or stratified sampling to select a representative number of persons to be questioned is recommended. However, due to the nature of this research attempts were made to approach all or as many as possible those householders located close to open watercourses, ponds and local rivers. In addition, all results were analysed according to the age and sex of the respondents, although such analysis did not always demonstrate differences in attitudes. However, sex and gender analyses of the results of the different research phases are attached as Appendices. The respondents in each site were of similar socio-economic background and such analysis would have not been valid. However, an overall assessment of the differences in attitudes based on socio-economic status between the different corresponding sites is presented in the discussion chapter where an overall evaluation of the work carried out is also given.

3.3 REVIEW OF THE INVESTIGATIVE METHODS USED

Social science focuses attention on particular issues and challenges, as well as on conventionally held beliefs about the social and natural world. However, social research differs from research in the natural sciences in that researchers are able to question the subjects of research directly. *"Unlike objects in nature, humans are self-aware beings who confer sense and purposes on what they do. We can't even describe social life accurately unless we first grasp the concepts that people apply in their behaviour."* (Giddens, 1997)

Several thinkers and researchers have attempted to synthesize some aspects of these major perspectives. In particular, Giddens has argued that our everyday actions are meaningful to us, but they also reproduce structures, which both enable and constrain our actions (Giddens, 1976; 1984; 1996), a position also shared by Roy Bhaskar. Habermas characterises these attempts as bridge-building attempts, aimed at fusing the twin aims of 'how' (understanding) and 'why' (explanation) in social research (Habermas, 1984; 1987; 1989; 1990).

The ability to explain and understand the findings of research within a conceptual framework that makes 'sense' of the data is the basis of any systematic study of the dynamics, content, context and structure of social relations. *'Theory aims at the production of thoughts which accord with reality. Practice aims at the production of realities which accord with thought. Therefore common to theory and practice is an aspiration to establish congruity between thought and reality".* (Cohen, 1984)

Social life itself is diverse and complicated and the practice of science, natural or social is not simply a choice between facts and theory. *"No longer a reliable difference between theory construction and empirical work"* (Baldamus, 1984).

In social research, methodologies are generally divided into two categories:

- Quantitative methodologies which involve the processes of collecting, analysing, interpreting, and reporting the results of a study. They use numbers to test hypotheses and take the form of surveys and statistical or experimental observations. They use tightly controlled methods.

- Qualitative methodologies, which try to use first-hand familiarity with different settings to induce hypotheses. They involve purposeful sampling, collection of open-ended data, analysis of text or pictures, and personal interpretation of the findings. They make use of interactive and humanistic methods seeking for active involvement of participants in data collection and have the form of open-ended observations, interviews, focus groups and interpretation of documents (Creswell, 2003).

As with theories, methodologies cannot be true or false, only more or less useful (Seale, 2004). Consequently, social research aimed at assessing perceptions and attitudes often makes use of both quantitative and qualitative methods either separately or in combination. This is known as the 'triangulation of methods'. There is wide debate amongst social scientists between the two

methodological approaches. A common perception of social research is that quantitative research is objective, while qualitative research is subjective. Quantitative research seeks explanatory laws, while qualitative research aims at in-depth description. Quantitative research measures what it assumes to be a static reality in the hope of developing universal laws, while qualitative research is an exploration of what is assumed to be a dynamic reality. Although some social science researchers (Lincoln & Guba, 1985) perceive qualitative and quantitative approaches as being incompatible. Others (Patton, 1987) are advocates of the triangulation of methods and believe that the skilled researcher can successfully combine them.

While earlier attitudes, in the 1950s and 60s, focused on the technical adequacy of the different techniques, in the 1970s, there was a wide debate over philosophical issues, such as the appropriateness of the use of natural science models to the social sciences. On the one hand, qualitative methods, especially in the form of participant observation or personal interviews, are thought to be restricted by idiosyncratic observations and participants who do not always allow the researcher to touch on very personal issues (Blalock, 1970). On the other hand, although many consider quantitative methods to be a scientific approach, a natural science model, which can be easily tested, they fail to take into account individual characteristics which may influence the participants' attitudes (Bryman, 1988).

A combination of quantitative and qualitative investigative methods was used in this multi-task research programme - a 'triangulation' of social research methods. The main reason for the use of the triangulation method was the nature of the project itself. Numerical data, gathered through questionnaires and qualitative data gathered via semi-structured interviews and focus groups, were utilised together to provide a holistic view of public and professional perceptions of stormwater management practices. The selection of different investigative methods, and their combination was made based on the needs of each research phase. As the three research phases were interrelated, this combination of methods succeeded in providing both hard data and in-depth information on matters related to stormwater management practices: amenity, biodiversity, sustainability, perceptions and preferences, safety concerns, and public involvement in planning.

3.3.1 The reasons for combining Quantitative and Qualitative Methods

The contrasting features of the quantitative and qualitative research methods have given rise to a wide debate between the proponents of the two methodological approaches. Although there are differences which promote antagonism between strong supporters of the two approaches, they are thought by many scientists to be closely linked and equally important in understanding the world (Brannen, 1992; Bryman, 1988). Combining quantitative and qualitative methods enables the researcher to crosscheck results for consistency and to offset any bias of a single research method. After all, hard facts, numbers, and words are required to analyse social issues. *"Quantities are of qualities, and a measured quality has just the magnitude expressed in its measure"* (Kaplan, 1964).

Triangulation was first introduced by Campbell and Fiske in 1959 during research in psychology and is frequently cited as a rationale for mixing qualitative and quantitative methods in a study. However, care should be taken when combining methodologies as the distinction between the two methods is not always 'clear cut' (Mason, 1996).

The choice of methodology simply depends on whether the preference is to count attitudes in a systematic way, or to take an analytic approach (Salomon, 1991). Consequently, linking the two methodological approaches can result in obtaining a more holistic view of the issue of interest. The main reasons behind this linkage are:

- Confirmation of the results of each approach by using the other method;
- Corroboration of the results to provide more detailed results and possibly lead to the development of new ideas on the matter of interest;
- Provision of precise and measurable results obtained through quantitative research is enriched by helpful details on attitudes gained through qualitative methods (Firestone, 1987).

Linkages between research methods are not as deterministic as they are often assumed to be. Qualitative and quantitative methods often share more common ground, narrowing the differences and incompatibility of the two approaches (Hammersley, 1992; Philip, 1998; Bryman, 2001). *"Researchers should think beyond the myopic quantitative-qualitative divide when it comes to designing a suitable methodology"* (Philip, 1998)

Qualitative methods can capture complexity and contradiction in the human and social world while quantitative methods can highlight the measurable social and personal aspects of life. *"By coupling the power of the general with the insight of the particular, such research illuminates people's lives and the larger contexts in which they are embedded"* (McLafferty in Seale, 2004).

Critics of combining methods argue that the assumptions behind the qualitative and quantitative approaches are fundamentally different both in terms of epistemology (nature of information) and in terms of ontology (assumptions about the nature of the social world). A fundamental criticism that triangulation is based on the assumption that social reality can be converged through the use of a multiple method, is 'naïve' (Blaikie, 1991).

However, triangulation of methods fails to recognise that different findings are likely to emerge from the different methods and that the researcher is then likely to interpret data in very different ways. Triangulation is also criticised for generating contradicting and non-consistent findings, 'philosophical critique of triangulation' (Seale, 1999). On the other hand, qualitative and quantitative methods can rarely be used to address exactly the same research question: *"It is highly questionable whether quantitative and qualitative research is tapping the same things even when they are examining apparently similar issues"* (Bryman, 1992).

Triangulation of methods is particularly recommended in social surveying where different actors are involved, due to the fact that approaching the different actors may require different practices in order to extrapolate valid results. Although in such cases, one research method could be considered to be the most appropriate for the assessment of attitudes of some of the parties involved, the same method may not work for others. Different methods are often used when attitudes of individuals with conflicting interests have to be assessed. One of the two approaches can then be used as a means of testing the results of the other. Qualitative research can be used as a source of hypotheses to be verified by quantitative research and to facilitate the construction of scales and indices. Quantitative research on the other hand can provide the evidence that more detailed analysis is required in certain issues. It can help in mapping these issues while evaluating the importance and strength of ideas through scaled analysis, and play an important role in selecting the target groups for qualitative research (Bryman, 1988).

A triangulation of methods was used in the current research programme. The assessment of the public perceptions of SUDS mainly used quantitative research approaches, while the results were also interpreted qualitatively. Although the assessment of perceptions of professionals

involved with SUDS mainly made use of qualitative methods, it also produced measurable and quantifiable results. The assessment of perceptions of stormwater management practices engaged a combination of quantitative and qualitative instruments. The selection of the different methodologies during the different research phases was based on the needs and the individualities of each research phase.

Care had been taken to ensure the quality of the social research in such a way that it fulfils the criteria of 'validity' and 'reliability'. The research outcomes should have a truth-value, produce true knowledge in order to be considered as 'valid'. They should reflect real situations that can be confirmed with future research, demonstrate consistency in the way the procedures engaged deliver the results so the findings can be considered as 'reliable'. The concept of reliability in research projects is closely linked to the idea of replicability. Replicable studies use reliable research instruments and this is considered as an essential precondition for studies to produce valid or true knowledge (May, 2001).

The current research was aimed at being both reliable – to maximise the possibilities of producing the same result from the same type of surveys if used on different occasions with the same object of study, and valid – to fulfil the aims of the research work in a way that the truth status of reports and results are not questioned (Seale, 2004). The triangulation method used is also as a technique for validating the study (Denzin, 1978).

Attention was paid to ensuring both 'internal' and 'external' validity. Internal validity refers to the validity of the different variables which in this case relates to the themes identified to be important for this research work. To ensure validity in the design of the surveys, the knowledge and experiences of other pieces of relevant research work and the theory related to the research topics and to the important themes/questions to be addressed, were investigated and taken into account.

External validity was achieved through representative sampling which is random sampling involving a high number of participants to ensure that the people studied were not unusual or atypical in any way, and that the results and conclusions could also be true for others in the population.

The reliability of this research work was ensured through maintaining standard procedures and techniques throughout the research programme. The procedures were also comparable with other studies. As a result, the outcomes of the current research work were comparable to the

results of other studies on the same or similar topics of interest, using the same or similar sampling procedures and research methods.

3.3.2 The public perception of SUDS – first research phase (Chapter 4)

Predominantly quantitative information was gathered for the assessment of public perception of SUDS undertaken during the first year of the programme (2001-2002). Door-to-door interviewer-administered questionnaires consisting of open-ended and scaled questions were used. This type of questionnaire collected some qualitative data but mainly gathered quantitative data, as the responses even to the open-ended questions were grouped and quantified. Consequently this part of the research can be considered to have made use of quantitative investigative methods.

Efforts were made to conduct the door-to-door surveys at a large number of the houses in all areas selected. Although a high number of households were approached, the response rate was approximately one third of households in the area. This was either because the householders/ occupiers were absent during the survey application or because they did not wish to participate. 580 questionnaires were completed (see Section 4.1.3. - Table 4-1) and the data collected provided a snapshot of local public perceptions. The results of this research phase were analysed using the 'Sphinx Survey' software package.

Quantitative methods usually include social surveys, experiments and collection of data. The door-to-door, interviewer-administered questionnaires included a combination of question types: open-ended, closed, and scaled. Open-ended questions are often used in quantitative research in conjunction with closed question as a mechanism for obtaining all the relevant details about a subject (May, 2001). The reason behind combining different types of questions in one questionnaire is to stimulate the respondents and maximise variation in the interview process. The aim is to ensure, that the variation between responses can be attributed to actual variations between interviewees. However, most questionnaires are pre-coded to allow the classification of responses into analysable and meaningful categories. Pre-coding is the allocation of a numeric code to each category of a variable to enable the preparation of data for computer analysis (Rose & Sullivan, 1996). The commonalities of responses received enabled the grouping of answers and the quantification of responses even to the open-ended questions in the first research phase.

Pre-coded or not, open-ended questions allow respondents to express openly their attitudes and avoids biasing providing respondents with a greater freedom in answering without indicating any possible 'suitable' answers. On the other hand, such questions are more difficult to analyse, and care should be taken on how the researcher interprets the responses of the participants, especially when sensitive issues have been raised. Consequently, clarity in language is also one of the main priorities in the questionnaire design. On the other hand, although closed questions are easier to analyse as they allow point-by-point comparisons between different kinds of people, at the same time they restrict respondents from expressing their ideas. However, they can very useful in identifying the strength of attitudes and they help to distinguish between strong supporters of an attitude and people who refer to an issue without being seriously concerned about it. However, questioning people is not an easy task: *"In reality, questioning people is more like trying to catch a particularly elusive fish, by hopefully casting different kinds of bait at different depths, without knowing what goes on beneath the surface"* (Oppenheim, 1992).

Several critics of quantitative research, claim that it fails to understand the 'meanings' that are brought to social life, and in this way it ignores the differences between the natural and social world (Filmer et al, 1972). However, most quantitative researchers would argue that they do not aim to produce a set of cumulative generalisations based on the critical sifting of data (Marsh, 1982). Although quantitative surveying provides the researcher with scientific information, there is wide debate on whether this information is representative of the larger population. Critics believe that *"researchers who generalise from a sample survey to a larger population ignore the possible disparity between the discourse of actors about some topical issue and the way they respond to questions in a formal context"* (Fielding & Fielding, 1986). On the other hand supporters of quantitative research go so far as to believe that the only way of getting an idea about attitudes is by quantifying them: *"There is no such thing as qualitative data. Everything is either 1 or O"* (Kerlinger in Miles & Huberman, 1984).

In the current research, almost identical questionnaires were used during the first research phase, in locations with different types of SUDS in order to produce comparable and reliable data covering all the different issues raised at that location. The role of the interviewer during the public perception surveys was to direct the respondent through the sequence of questions, and only provide clarification when necessary without elaborating on the topic in question in order not to influence the answers. The researcher did not provide the interviewees with any information and was not allowed to bias the respondents in any way. The neutrality of the

interviewer's role was emphasised in this manner. The basic rules during these interviews included:

- the standardisation of explanations, maintaining a concise way of asking questions and recording the answers in accordance with the survey instructions (Fowler, 1988);
- eliciting responses only from the person with whom the interview is being conducted;
- not prompting or providing personal views;
- not interpreting meanings during the course of the interview, and not improvising (Fontana & Frey, 1994);
- framing the questions in a way that eliminates misunderstandings amongst participants;
- choosing a representative sample of participants; no setting can be shown to be socially homogeneous and having people sharing the same ideas (Hammersley & Atkinson, 1995);
- respecting the individual characteristics of the respondents, such as language proficiency, cultural or idiosyncratic characteristics, which can influence responses. (Gomm, 2004).

Although this method is difficult to apply due to the need for good communication skills on the researcher's part and it is also time consuming, it was chosen as it has a number of advantages:

- Door-to-door surveying is a direct method, which encourages people to participate more than when they are asked to fill-in and post questionnaires or answer phone surveys. The respondents often feel that the researcher shows respect and values their attitude when he/she chooses to hold a face-to-face conversation rather than 'hiding' behind an impersonal method of surveying, which does not involve personal contact;
- The interviewer can control the context and the environment in which the interview can take place. For instance, the interviewer can make sure that the questions are asked and therefore answered in the correct order and by one person;

- When the survey takes place on the door step, a familiar environment, the respondents feel that they have the free choice of whether to participate or not. Since they feel comfortable with the setting, they tend to express themselves more openly;

- The information delivered through open-ended questionnaires is rich and realistic. The respondents are not constrained to choose between given answers, but can express any possible opinions;

- There is less chance of ambiguity. The responses provided are not biased towards any suggestions made by the researcher.

Aims of the Questionnaire on Public Perception

The aims served by the SUDS pond's questionnaire, were framed to meet the interests of the parties involved (the funding bodies of this research programme) in assessing public attitudes on SUDS and the ideas incorporated within the concept of introducing green open spaces and water features in urban settings. The different themes were relevant to urban green spaces and water features. The themes found in the literature and presented in Chapter 2 were used for guidance in formulating and setting the specific aims of this research phase, which were to record and assess:

- the overall public concerns on global, local environmental issues, and the public perceptions of nature and water pollution issues;

- public awareness of SUDS and to evaluate any information provided to them by developers / local authorities;

- perceptions of SUDS ponds and wetlands (perceived advantages and disadvantages), and landscape preferences, and to identify the perceived amenity and biodiversity benefits of SUD ponds;

- to evaluate safety concerns and to compare those concerns with other types of safety risks present within urban areas;

- suggestions for improvements to the ponds' performance or appearance;

- the sustainability element of SUDS in comparison to other sustainable practices within a city;

- the effect of SUDS on house pricing and saleability;
- the need for further information and public engagement in planning.

The question related to the effect of SUDS on house pricing and saleability does not relate to the themes emerging from the literature but was formulated as a response to the relevant interest expressed at the time by the Environment Agency of England and Wales.

Questionnaire Design & Structure

The different ideas and themes identified in Chapter 2 as being important for the understanding of the functions and benefits of SUDS and for their application and acceptability within urban areas, were used as the basis for designing the questions of this part of the research. In other words, the questionnaire structure for the public perception surveys was developed following the thematic analysis of Chapter 2. The interest of analysing these prominent ideas, within landscape preferences of open water spaces, was used as a gnomon for the assessment of attitudes and for providing conclusions on the sustainability element of the systems.

The questions were selected in such a way as to address the main issues of interest for this project and to reflect either directly as they were expressed, or extrapolate indirectly, attitudes on the themes of interest from Chapter 2. For example, although they were no direct questions on amenity and biodiversity, it was expected that many participants would refer to these issues due to on-going debates on whether the SUDS ponds provide amenity and biodiversity benefits in the areas where they are located.

Several factors were also taken into account when designing the questionnaire:

- The questionnaires had to be appropriate for householders of any occupation and educational level and had to be as clear and as simple as possible;
- Questions had to be brief but with enough content to allow the researcher to gather as much information as possible without tiring the participants;
- Technical terms or language that could confuse or lead to association of rainwater management with particular periods of heavy rainfall and floods in England, had to be avoided;

- Care had to be taken not to make people suspicious and raise their concerns about SUDS.

The Questionnaire was divided into 7 groups of Questions:

I. Questions 1-4 are a general and brief introduction to the questionnaire and address the general *concern and awareness* over global and local *environmental issues*. This group of questions prepares the ground for the discussions to follow. The first two questions tried to identify the interviewee's global environmental concerns and what their perception of a polluted environment would be, while questions 3 & 4 refer to water pollution issues;

II. Questions 5-9 relate to the *public awareness of SUDS* and also introduce and guide the discussion to the specific matters of interest related to SUDS. Through Questions 5-9 the researcher tried to assess the participants' level of awareness of SUDS, and their knowledge of the purpose they serve. These questions are also used as screening questions to identify those participants who were aware of SUD systems and with whom a more elaborate discussion could be held. Those participants who are unaware of the issues relating to SUDS continued reference only to the local pond and care should be taken not to provide information on the function and purpose of the pond, to avoid biasing the answers;

III. Questions 10 & 11, try to identify the public's perception on the advantages and disadvantages of ponds within their community. These questions are expressed in very general terms to allow participants to express openly their attitudes in relation to the SUD ponds. As expected, issues of major concern and debate for the interviewees such as *amenity*, *biodiversity*, and perceptions towards *water and landscape preferences* were among the perceived advantages, while *safety* and lack of *public education* where disadvantages. All those issues arise in the literature as central within perceptions of green open spaces and water features in urban areas, they are directly linked to the relevant themes presented in Chapter 2, and were considered to be of major importance for this research work;

IV. Questions 12-15 are addressed only to those who mention safety of ponds among the perceived disadvantages. These questions are aimed at specifically evaluating the *safety* concern related to SUD ponds and comparing them with other types of risks present within urban environments;

V. Question 16 refers to suggested improvements which might make the ponds more readily acceptable within their residential area. This question is directly linked to the theme of *landscape preferences* in urban areas;

VI. Questions 17-19 attempts to relate the presence of SUDS to house prices since this was a concern expressed by the planning authorities, and the perceived *sustainability* element of SUDS, which reflects the relevant theme in the literature. SUDS are compared to other sustainable practices in urban environments, and are placed within the concept of a sustainable city;

VII. Questions 20-22 attempt to identify the need of the participants for further information, education regarding SUDS, and their willingness to be involved in the planning of new SUD schemes, reflecting the theme of *public involvement and education.*

A complete copy of the Questionnaire is attached as Appendix I-B, and a flow diagram showing the structure of the questionnaire is included as Figure 3-1:

Ponds' / Wetlands' Questionnaire

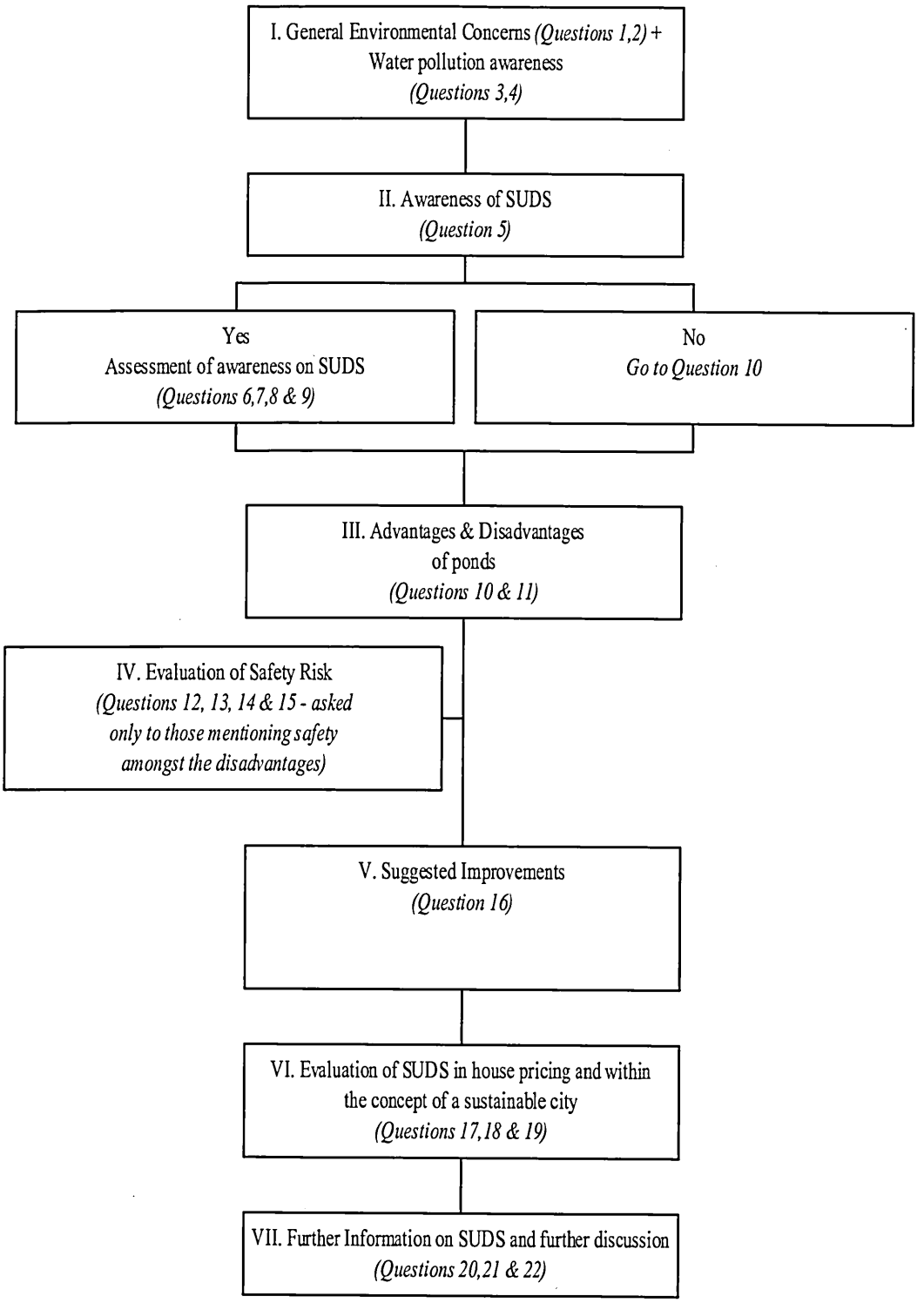


Figure 3-1 Flow Diagram of the SUDS Questionnaire

3.3.3 The professional perception of SUDS – Second research phase (Chapter 5)

During the second year of the research (2002-2003), the stakeholder perception of SUDS was assessed through interviews and focus groups with professionals involved in the research, design, application, and/or implementation of SUDS. The basic criterion for approaching the selected professionals was their expertise and involvement with SUDS. The participants at this research phase were developers, planners, design engineers, academics-researchers, landscape architects, environment protection officers (EPOs), water authorities, and local authorities.

Two methods were used to assess the professional perception of SUDS:

- Sixty semi-structured interviews with professionals involved with SUDS;
- Three focus groups with groups of professionals.

Details of interviews and focus groups held are included in Section 5.1.2.

The knowledge and experience gained through the first year of the research on assessing the public perception of SUDS was used as a basis for formulating the following research phases and for choosing the most appropriate research methods. The assessment of professional perceptions of SUDS, apart from being of interest to all the bodies related to this research programme, were also thought to provide useful information to help to understand how SUDS are perceived in general. Information on problems involved to SUDS application, and ways to improve SUDS schemes and increase their acceptability would also be gathered. The experience with the public perception surveys and experiences from other research programmes addressed to professionals (M^{c}Kissock, 1999; Howe & White, 2002), indicated that strictly quantitative methods, such as questionnaires, which work well for the public, are not suitable for assessing opinions of professionals, who usually have strong opinions based on sound knowledge and personal interests. Personal interviews and focus groups are therefore suggested for this type of research work.

The term qualitative interview generally refers to in-depth, loosely or semi-structured interviews, which can be referred to as 'conversations with a purpose' (Burgess, 1985). Supporters of qualitative research argue that experiments, official statistics and survey data may simply be inappropriate to some of the tasks of social science, as they do not take into account individuality. Hence, while quantification may be useful, it can at the same time conceal as well as reveal basic social processes (Cicourel, 1964; Denzin, 1970; Schwartz &

Jacobs, 1979; Hammersley & Atkinson, 1983; Gubrium, 1988). The aforementioned researchers believe that all data, gathered through social research, are qualitative as they are related to the essences of people (Berg, 1989): *"All research ultimately has a qualitative grounding"* (Campbell in Miles & Huberman, 1994). Qualitative data are gathered via observations, interviews, or documents, through a sustained period of time, with emphasis on people's experiences and perceptions and assumptions (Van Maanen, 1977).

The qualitative interview as a particular investigative method only became necessary in post-war social research. In qualitative research interviews, the researcher provides minimal guidance, and the data collected are characterised either as corrigible which are data related to matters of fact, or as incorrigible - data related to attitudes, beliefs and understandings (Ayer, 1956). The main difficulty imposed on the researcher in the case of incorrigible data is the distinction between the truth and a personal opinion. However, on many occasions, validation of the data collected occurs either through the use of quantitative data such as the use of statistics, or via interviewing a large number of participants on the same topics. This is a practice which is applicable when the topics of the interview are not related to personal information but to social issues (Bryman, 1988).

General features of qualitative research are:

- It is usually applied to everyday life situations of individuals or groups;
- The researcher gains an holistic view of the study topics;
- The researcher captures data on the perceptions of local actors through empathetic understanding. Verstehen, as it is internationally known nowadays, is a term introduced by Max Weber to describe his attitude towards focusing on the understanding of the participants (Filstead, 1970). A major task of qualitative surveying is to interpret the results in a way that promotes understanding of the way people think and act;
- The researcher is able to provide a detailed analysis of the topics selected if these are judged to be of major interest for the survey;
- Language is the main analytical tool and the researcher is the main analytical measurement device.

Qualitative approaches have the advantage that the respondents are free to express attitudes that were not thought of by the interviewer. However, it is almost inevitable that the interviewee will move away from the topics as originally formed in the interviewer's mind. The main problem with this is that the interviewer has to set the limits of the discussion, control the interview, and decide which parts to exclude from the data analysis (Measor, 1985). Qualitative interviews, even though the interviewee may ramble, allow the researcher to gather in-depth information on matters of interest that cannot be pointed out using a strictly structured investigative method.

Qualitative interviewing can take many forms, from interviews following a standard format, a list of topics or themes to be covered in a loosely planned order, to an invitation to the interviewee to talk on whatever issue they feel is of relevance. The individuality of qualitative interviewing lies in the fact that frequently the interviewee is a person of higher social status than the investigator. Thus, a loosely structured research agenda allows the respondent a degree of freedom, appropriate for the circumstances (Platt, 2002). The in-depth interview is modelled after a conversation between equals, rather than a formal question-and-answer exchange, and it is based on repeated face-to-face encounters between the researcher and the interviewee. Far from being a data collector, the interviewer him/herself, is the research tool, with the role to ask the right questions in the most appropriate way (Taylor and Bogdan, 1984).

Semi-structured interviews are normally placed somewhere between the structured and loose methods of assessing attitudes. Questions were specified within this research project but the interviewer was freer to probe beyond the answers in a manner, which would appear prejudicial to the aims of standardisation and comparability. The interviewer had the flexibility to seek both clarification and elaboration on the answers provided allowing the collection of qualitative information on the issue in question (Fielding, 1988). However, on top of gathering useful quality data, the researcher could also quantify results up to a certain degree due to the commonality in responses. The quantitative results were analysed using the 'Sphinx Survey' software package.

The semi-structured interviews of the professionals followed a similar format to those of the public. They maintained a loosely-structured format, and the questions/ themes were derived from the major issues identified during the first phase of the research with the members of the public and they reflected the main themes of interest of the research programme. The methods used ensured that comparisons between public and professional attitudes on SUDS could be

compared. The open-ended and flexible questions of the semi-structured interviews were grouped into different themes in such a way as they provided a better insight to the interviewees' view, understandings, experiences and opinions (May, 2001; Seale, 2004).

Although the interviews addressed to professionals were in the form of questionnaires, they were classified as a semi-structured interviews for the following reasons:

- They consisted of open-ended questions referring to general issues with no specific references to certain issues;
- The interviews were in the form of informal discussions following a standard outline, rather than that of a questionnaire;
- The researcher most often had to add, remove or modify questions according to the flow of the discussion;
- The questions were used more as topics for discussion rather than taking the form of questions and answers.

Focus groups were also used during this research phase. Recently there has been an increasing trend towards the use of focus groups which originated in market research in the 1920s, and have been widely used in social science since the 1940s (Kitzinger, 1994; Merton, 1987). They were initially used as a supplement to quantitative research methods. By feeding the questionnaire results back to the research participants in a group discussion or focus group, allows them to account for their own responses in a qualitative manner (Merton, 1987).

These discussion sessions are effectively loosely structured interviews with more than one participant. The investigator often tries to bring together a cross section of different types of people or of people with conflicting interests on the topics of interest. On other occasions the group of participants consists of people with many similarities, a method used when communication and group interaction is desirable. The facilitator asks questions and directs the conversation, usually in an informal way. A series of issues are covered with the objective of bringing up the differences and contradictions between participants, often signifying differences in attitudes. The interaction between the participants and the relaxed atmosphere of the focus group stimulates thinking and often helps in raising issues that would not otherwise have been raised. Focus groups have the advantage that they allow participants to generate their own questions and concepts and pursue their own priorities, while at the same time the

different perspectives of each issue are examined and taken into account. Focus groups can also investigate the effect of social interactions, peer communication and group norms in formulating common attitudes within societal groups (Barbour and Kitzinger, 1999). This method also allows group dynamics to develop and consequently it adds the element of realism to the research effort (Weisberg et al., 1989).

The focus groups in this research phase provided an in-depth analysis of the issues raised and investigated possible changes in attitudes due to group interaction. The focus groups were useful in clarifying the key research concepts mentioned during the semi-structured interviews. This method also had a dual relevance to interview methods, providing both a tool in research design and a complementary method of data collection.

However, a principal difficulty often faced is the interpretation of the results in qualitative research including interviews and focus groups. The qualitative analysis used, which was also followed in the analysis of the professional perception surveys, took the form of a thematic analysis in which the researcher, after completing the cycle of interviews, analyses the results based on the responses and ideas provided for each topic of interest separately (Gomm, 2004).

Aims of the research on attitudes of professionals involved with SUDS

The aims of this research phase were based on the main themes of interest related to SUDS as outlined in the literature review (Chapter 2) and were identified by members of the public during the first research phase of the currently presented programme. Those aims were:

To quantify as well as qualify the professional perception of SUDS and relate those to relevant literature in relation to:

- Amenity;
- Biodiversity;
- Safety;
- Design characteristics;
- Barriers to SUDS implementation;
- The possible effect of SUDS on house pricing and saleability.

Environmental awareness issues were not discussed with the professionals involved with SUDS since their environmental awareness, concern and relevant knowledge was not under investigation. This does not ignore the fact that there is considerable debate amongst the engineering fraternity on the sustainability element of SUDS, although SUDS are widely recognised as being more sustainable than traditional drainage especially by those professionals who have worked on SUD schemes. In consequence, a question to professionals on the sustainability of SUD schemes would have opened a discussion based on a "philosophical grounding" that would not provide valuable results for this research programme.

In contrast, other issues which were considered to be more appropriate for discussions with professionals and could not be addressed to the public in the same way included the design characteristics of the schemes and on the barriers to SUDS application. The effect of SUDS on house pricing and saleability was also an issue of interest for the developers and the Environment Agency of England and Wales and it was important that it should be assessed in this part of the research.

Questionnaire Design & Structure

The questions were selected in such a way as to guide the discussion and not the answers. However, the wording was not strictly controlled and all questions could be elaborated or rephrased during the course of discussion according to the responses and professional interests of the participants.

Overall, the semi-structured interviews were divided into 6 groups of questions or topics:

I. Questions 1-3 directly addressed the *amenity* issue of open spaces and SUDS in urban areas. These questions tried to identify the professionals' perception of amenity within the SUDS concept, and their understanding of the public perception of amenity.

II. The second group of questions referred to the *biodiversity* of SUD systems as a matter of both personal attitudes and their estimation of public perception;

III. The third group of questions referred to the *safety* concerns related with SUDS both as a matter of personal and public perception;

IV. Questions 8-9 attempted to identify the influence that design characteristics have on public acceptability of SUDS systems and was linked to the theme of *landscape preferences,* and of *public involvement/ engagement in planning*;

V. The next group of questions referred to the possible effect SUDS have on house pricing and saleability;

VI. Finally, participants were asked to outline the barriers to SUDS application and to make any further comments in relation to SUDS.

A complete copy of the Questionnaire is attached as Appendix II-A, and a flow diagram showing the structure of the questionnaire follows as Figure 3-2:

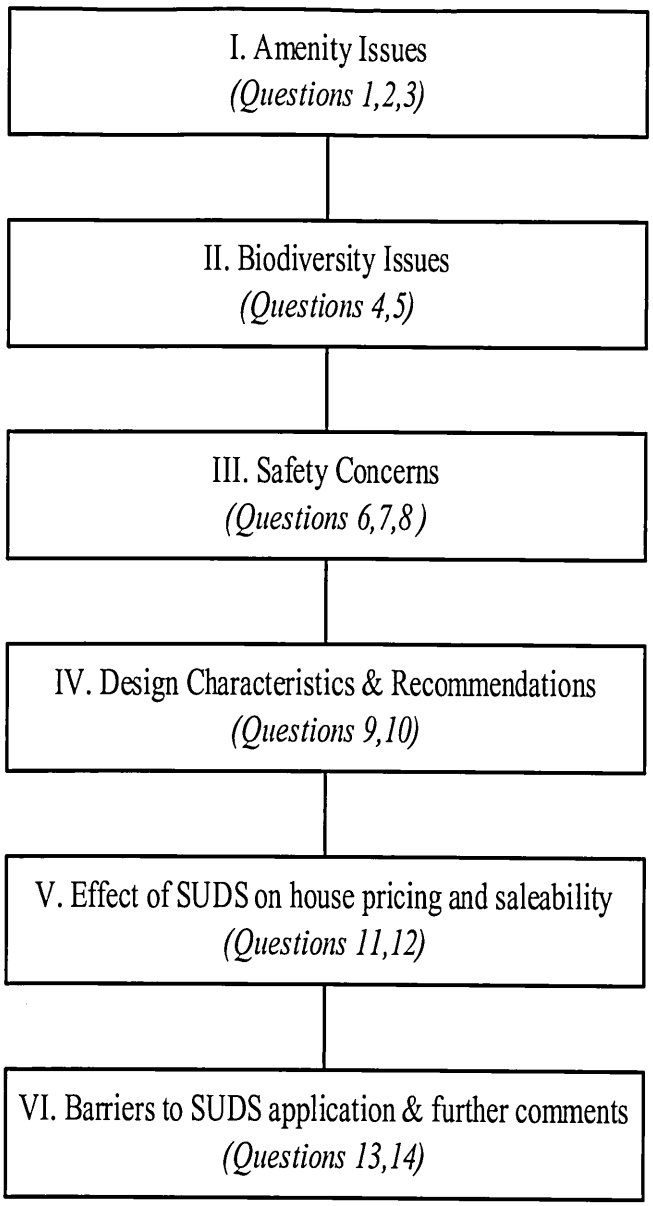


Figure 3-2 Flow diagram of semi-structured interviews addressed to professionals

Focus Groups

Three Focus Groups with professionals involved with SUDS addressed the same topics/ themes as the semi-structured interviews. The aims for the focus groups were, first, to gain an insight into issues brought up in the interviews, and secondly to be used as a means for testing the reliability of the results of the interviews. The diverse opinions expressed and the debates generated during the Focus Groups gave a good indication of the actual attitudes and trends in thinking amongst individuals with a common topic of interest, in this case SUDS. Emphasis was also given to issues important for this research such as amenity.

If it could be assumed, as a Null Hypothesis, that the results of the semi-structured interviews were indicative of the trends in attitudes towards SUDS, the results of the Focus Groups were used to support or reject this hypothesis. Although this assumption can be considered as wrong due to the fact that the survey is based on personal perceptions which are not easy to quantify or classify as right or wrong, the interviews provided results, both quantitative and qualitative, which demonstrate similarities in perceptions. Consequently, it is very important to accept these similarities as trends in perception and understanding of SUD schemes, without rejecting the opposing opinions.

The issues raised during the Focus Groups were also related to amenity, biodiversity, safety of SUDS systems, SUDS design, the effect on house pricing and saleability and the perceived barriers to SUDS application. The facilitator followed the same list of topics as with the semi-structured interviews to guide the discussion. However, interesting debates were stimulated during the Focus Groups and other issues were raised by the participants.

focus groups were held with members of a city council, with researchers and academics involved with SUDS, and with environment protection officers (EPOs). Discussions were tape recorded, with interviewees' permission and analysed.

3.3.4 The Comparative Study on Stormwater Management Techniques – Third Research Phase (Chapter 6)

The experiences obtained during the first and second research phases were used as the basis not only for choosing the most appropriate methodology but also for selecting the themes to be investigated through the perception surveys of the third research phase (2003-2004). The third

phase comprised a comparative study of the perceptions of stormwater management practices in three densely populated European cities facing similar storm water management problems. In total, 200 questionnaires were completed in Glasgow and London and 25 personal interviews were conducted in Athens.

The cities selected were Glasgow in Scotland – UK., the west London area in England - UK, and Athens – Greece. All sites are located within flood-prone suburban areas, and different stormwater management techniques have been proposed or adopted. In the case of Glasgow a new stormwater management plan was proposed. The plan included the reopening of culverted streams running through certain urban areas and the introduction of SUD ponds to provide flow attenuation and support stormwater conveyance to and from the newly de-culverted streams. In London, the first phase of the reopening of the River Brent running through Tonkyngton Park and its restoration back to its natural form had already been completed prior to the current research programme. In Athens, a different approach has been adopted for the stormwater management of a large area of the city. This included the culverting of and construction of a motorway over the biggest river running through the capital, Kifisos River.

The reasons behind choosing these three areas for the comparative study were:

- All three areas are flood prone, and they often face flood incidents with direct effect on the lives and well being of local residents;
- All three areas are within suburban areas of metropolitan cities;
- Different stormwater management plans are considered or are already constructed. All three plans involve river management;
- The case of Glasgow involves solutions which combine SUDS with river management, while in London and Athens river management options have been implemented;
- The case of London can be considered as a good practice example of river restoration - the current trend in river management;
- In Athens the approach selected was the result of the prioritisation of road work higher than the stormwater management requirement;
- The decision to culvert the River Kifisos in Athens and to carry out the road works was taken under the pressure of the 2004 Olympic Games and had several political and

social implications. It is considered more of a political rather than an engineering decision (Aloniatis, 2002). In the light of the 2012 Olympic Games in London, interest was expressed by the Environment Agency and SEPA, as funding bodies of the research programme, to assess the influence of a political decision on river management and urban planning on the public and life of the city.

The comparison of the three different but interconnected paradigms provides information relevant to stormwater management and planning, on how to increase public acceptability of stormwater management schemes, on current trends in river management, and on issues that have to be taken into consideration prior to planning and construction.

Different investigative methods for the two countries were required because of the different stormwater management approaches, socio-economic and cultural backgrounds, and institutional and the administrative practices and liabilities in the UK and Greece. However, as similar methods as possible were used in the surveys carried out in Glasgow and London as similarities in conditions allowed.

A 'triangulation of methods', combining of quantitative and qualitative investigative approaches, was used in the comparative study of the different areas. This is presented separately below.

Aims of the Questionnaire and the Semi-structured interviews of the Comparative Study

The aims of the comparative study took into consideration the reasons for undertaking the comparative study, the interest expressed in the comparative study mentioned previously, and the themes in literature identified in Chapter 2. Several factors influence the choice of a specific stormwater management plan and the public acceptability of open rivers within specific urban areas including as amenity, biodiversity, sustainability of the system, landscape preferences, safety, and public engagement in the planning processes. In the case of Glasgow the stormwater management plan proposed was under consideration by the City Council and Scottish Water at the time of the survey, and public information and engagement were high priorities. In Brent, a public awareness campaign was undertaken in 1999, prior to completion of the first phase of the River Brent enhancement plan, while in Athens there was a complete absence of public consultation in the decision to culvert the Kifisos River.

The active involvement or not of the public in the decision making processes were considered very relevant to this research and assisted in formulating the aims of this research phase, which were:

- To assess the overall concerns of the public on global and local environmental issues and the public perceptions of nature, water pollution, and flooding issues;
- To assess perceptions on and evaluate the stormwater management plans proposed in an effort to link them to landscape preferences;
- To assess the meaning of amenity for the public;
- To evaluate safety concerns related to the stormwater management plans, compare them with other risks within a city environment and assess the way perceptions of risk are formulated in modern society;
- To record suggestions from members of the public to increase the acceptability of open rivers within urban areas and associate them with landscape preferences;
- To assess the sustainability element of open rivers in comparison to other sustainable practices within a city;
- To compare perceptions of stormwater management practices in the three areas of interest, identify and explain the similarities and differences, and identify the need for public engagement in planning.

The effect of river management options on house pricing and saleability was not identified as a theme for the comparative study since the vast majority of houses were already built in all the new river management plan areas. Questions relevant to house pricing were not included.

Questionnaire Design & Structure

Glasgow & London

In Glasgow and London, door-to-door, interviewer-administered questionnaires were used. These consisted consisting of open-ended, scaled questions, collecting of mainly quantitative data. Since the responses to the open-ended questions were also grouped and quantified, some qualitative data was also provided. The researcher did not indicate answers to the participants who were free to express their opinions openly. This method was chosen for two main reasons:

- It was considered as the most suitable method to deliver the most realistic results. The reasons are the same as in the public perception surveys of SUDS – Section 3.3.2;

- To maintain a consistent approach in assessing public attitudes throughout this research programme, since the same qualitative methods were used for the assessment of public perceptions in the first research phase related to SUDS implimentation.

The questionnaires used in Glasgow and London had the same structure, referred to the same topics, and included identical general questions and different site-specific questions. The site-specific questions referred to the stormwater management schemes proposed including river restoration techniques in combination with the use of SUDS for the two Glasgow areas, as well as to the river restoration scheme already completed in London.

In addition, a postal survey was used in London to gather attitudes on the river restoration scheme on the western part of the housing estate which was not covered during the door-to-door surveys. This was mainly for safety reasons since there was a perception that part of the area suffered from a high crime rate. Consequently, it was decided to send out a postal survey in this area in collaboration with Brent Council and the completed questionnaires were analysed by the author. The postal questionnaires were identical with the door-to-door survey in the area to allow a joint analysis of the results. The response rate to the postal questionnaire at about 2% was very low. This is believed to be because local residents may have participated in similar surveys in the past, and the area is of a low socio-economic and educational background.

Analysis of the results of this research phase used the 'Sphinx Survey' software package.

The questionnaires used in Glasgow and London were divided into 6 groups of questions which were based on the questionnaires applied on SUDS. In turn, this was for consistency, the needs of the current surveys (special characteristics of each study), and the themes identified in the literature in chapter 2. The findings of the public awareness campaign in Brent in 1999 in relation to that individual scheme also informed the design of this questionnaire. For example, the questions referring to the use of the park, frequency of visiting and for what purpose were considered to give useful background information.

The groups of questions are as follows:

I. Questions 1-5 assess awareness and concerns over global and local environmental issues. This group of questions is an introduction to the whole questionnaire and prepares the ground for the discussions to follow. The first two questions try to identify the major global environmental concerns of the interviewee and their personal contribution to catchment pollution, while Questions 3, 4 & 5 refer to awareness and water pollution of the local stream;

II. Questions 6 - 10 refer to the flooding issue of the area, and specifically to awareness of flooding events and the way local authorities and other public bodies deal with flooding when it occurs. This group of questions refers to flooding issues which are of particular interest.

III. Questions 11 – 13 (14 – 15 in the London questionnaire), try to identify public perceptions about the proposed or completed scheme and its perceived advantages and disadvantages. In the London questionnaire questions 14 & 15 refer to the perception of the term amenity, the frequency of use of the park, and the landscape preferences in relation to the schemes. These questions are addressed only to those who mention amenity themselves;

IV. Questions 14 – 17 (or 16 – 19) are addressed only interviewees who mention safety of ponds among the perceived disadvantages. These questions are aimed specifically at evaluating these safety concerns and comparing them with other types of risks within an urban environment;

V. Questions 18 – 19 (or 20 – 21) refer to respondents suggestions about alternative schemes and improvements which might make the current scheme more acceptable within their area. This group of questions was based on the thematic analysis of the landscape preferences;

VI. Question 20 (or 22) try to assess the sustainability element of the stormwater management scheme proposed or implemented through comparing the different sustainable practices within the residential areas;

A copy of the door-to-door questionnaire used during the comparative study is attached as Appendix III-A. A flow diagram showing the structure of the questionnaires is included as Figure 3-3:

Stormwater Management Questionnaire applied in Glasgow & London

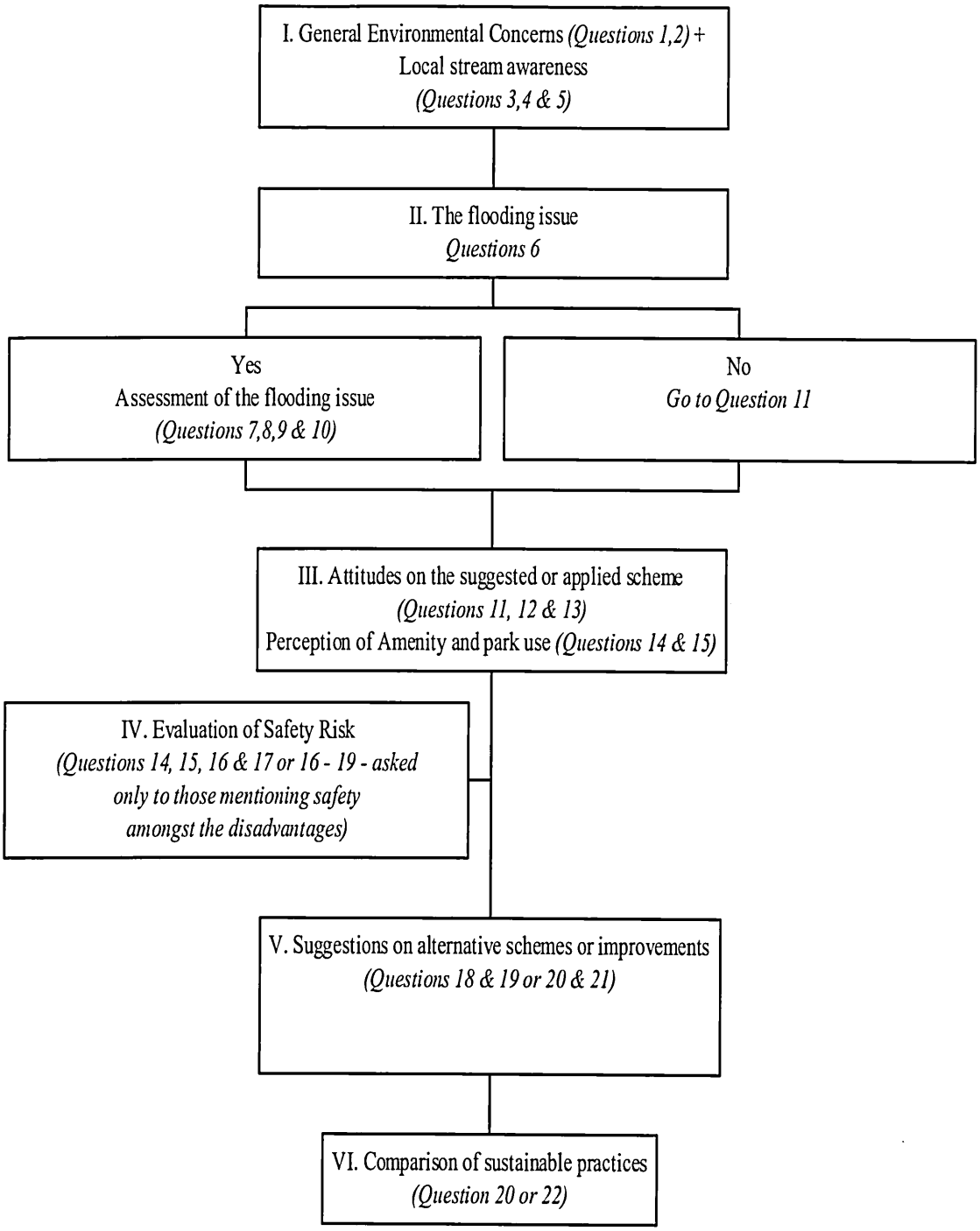


Figure 3-3 Flow Diagram of the Stormwater management Questionnaire applied in Glasgow & London

Athens

A door-to-door survey could not be undertaken in the area of interest in Athens and the most appropriate survey method was the assessment of the attitudes of professionals involved, directly or indirectly, or interested in the stormwater management scheme. The participants in this survey were: academics, researchers, consultants, employees of the city council and members of the public belonging to a community engagement group. Semi-structured interviews were used for the survey.

The reason for not applying a door-to-door survey in the case of Athens was socio-political. At the time of the survey in spring 2004 there was a wide debate, with social and political implications, on the decision to culvert the River Kifisos and to construct the motorway. Due to the high degree of opposition to the culverting works expressed by the public, by the scientific community in Greece, consultants' companies, political parties, the Ministry of Environment, Physical Planning and Public Works, when contacted, did not give permission for the survey. The main consideration of the Ministry was that such a survey could give rise to even stronger objections and opposition to the works and to public outcry, with obvious political implications especially in the light of the upcoming Olympic Games in August 2004. This was considered to be undesirable at the time in question. Consequently, it was decided that the most appropriate way to assess perceptions was not a door-to-door survey but the use of semi-structured interviews with professionals and with members of the public. Semi-structured interviews usually work well with professionals or other participants who have formed strong opinions. The members of the public who were questioned had also formed strong opinions on the issue of the river culverting since they were residents of the areas affected by flooding and the construction works, which were ongoing at the time of the survey. A face-to-face, personalised interview was also more appropriate for the assessment of public perception rather than the application of a more general questionnaire.

During the semi-structured interviews the participants could lead the discussion to the main topics of their interest. The list of questions / topics was mainly used to guide the discussion without biasing answers.

The semi-structured interviews covered 5 main topics, which were derived after examining the existing situation in the River Kifisos, as well as from the themes identified in literature. Themes such as amenity, biodiversity, safety, preferences (constructural and landscape) were covered directly or indirectly through discussions with the participants:

I. The first topic relates to water quality in the Kifisos River, and the issue of environmental awareness in general. Participants were asked to rate the river water quality and, if possible specify the sources of pollutants;

II. The second group of questions refer to the flooding issue, awareness of the flooding problem, personal experiences and any relevant details, also with reference to public safety and the risk associated with flooding;

III. The third topic attempts to investigate attitudes to the river culverting project, landscape preferences for the specific river in relation to amenity and biodiversity;

IV. The fourth topic refers to any suggestions either related to the current works or to suggestions for an alternative plan, in matters of construction, function, and landscape preferences;

V. Finally, participants were asked about the safety risk of open water within residential areas. As the respondents in the Athens survey were mainly professionals with strongly formed opinions, or residents affected by the river and of the culverting works who have already taken such issues into consideration, this question was unlikely to bias their answers or raise concerns that were not present before. However, it is interesting to assess the perception of safety in the different sites where the comparative study was applied, and to try to identify differences in attitudes based on design characteristics, prioritisation of concerns and education of the participants on relevant issues.

A copy of the list of questions is attached as Appendix III-C and a flow diagram showing the structure of the semi-structured interview follows as Figure 3-4.

Semi-structured Interviews applied in Athens

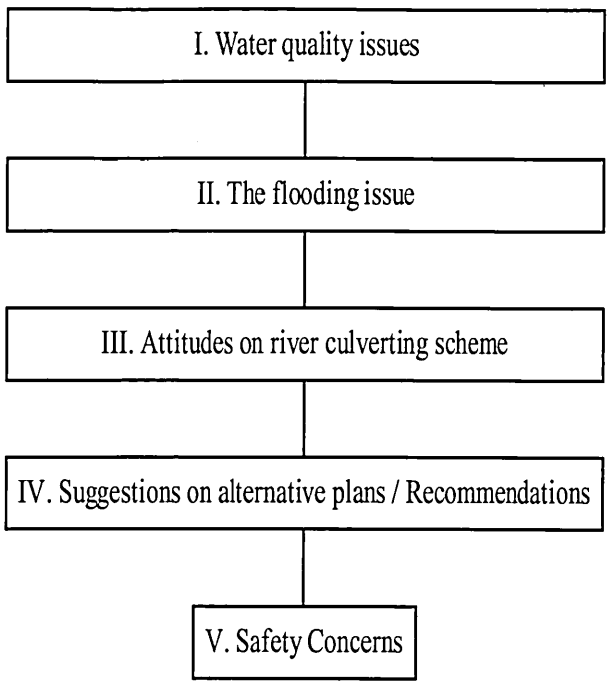


Figure 3-4 Flow diagram of semi-structured interviews

In all three areas of interest for the comparative study there was extensive coverage in the local press of the flooding issues and the proposed or implemented solutions. Therefore, the attitudes expressed by the local press were also investigated in all three areas of interest (Glasgow, London, and Athens) within the framework of this research programme. This type of literature search was used to understand and evaluate public attitudes towards the schemes, as expressed spontaneously though the press.

3.4 DISCUSSION - REFLECTIONS ON THE RESEARCH PROCESS

The triangulation of investigative methods, providing the balance between quantitative and qualitative approaches, was considered to be the most appropriate way of assessing the attitudes of the different actors to stormwater management practices. The methodology was carefully chosen to address the needs of the research programme, and to enable an holistic view on the perceptions and trends in the implementation of different stormwater management techniques to be gained. Efforts were made to associate the ideas expressed by members of the

public with those of professionals active within the field of urban runoff management. This was achieved through the use of similar or interlinked methodologies that were either complementary or were used as testing tools for the other methods. The questionnaires, the semi-structured interviews, and the focus groups used within this research programme followed the thematic analysis of issues related to the use of SUDS and river management schemes within urban areas as identified and analysed in Chapter 2. The themes identified formed the theoretical grounding and guidance for the design of all the surveys in this research programme. The design was also informed by the characteristics of each research phase, that is, the stormwater management issues in the area, the scheme characteristics and specific construction and social issues.

There were sufficient questionnaires and personal interviews to provide enough information for quantitative, in-depth analyses. In total, 620 door-to-door questionnaires, 60 personal interviews and 3 focus groups on SUDS and 200 door-to-door questionnaires, 25 personal interviews and 1 focus group on river management options were conducted during the course of the research.

A combination of investigative methods were used for assessing public and professional perceptions of stormwater management schemes. A plethora of information was gathered, which is considered to have provided a good basis for both quantitative and qualitative analysis. However, the diversity in characteristics and stormwater management issues between the selected sites and the difficulties in comparing the data obtained may be considered to be a shortcoming of the research. This shortcoming was overcome by analysing and quantifying in a consistent way, when possible, the information obtained. This also enabled comparison of data between the diverse areas.

The qualitative information gathered succeeded in providing an in-depth analysis and an holistic approach of the issues at hand. This information was used to better explain and support the quantitative results since both types of analysis concluded with similar outcomes. Qualitative analysis is often used to add an extra dimension to the issues at hand and to provide explanations on why and how perceptions are formulated and which factors affected them.

The validity of the results and procedures to be followed was ensured by designing and applying surveys which were expected to support true, 'valid' results. To ensure validity the design of the surveys was informed by experiences from other pieces of similar research and by theoretical approaches, while the sampling processes focused on representativeness. In

addition, respondents in the questionnaire survey were selected randomly, the main criterion being their access to the water body or proposed management scheme. Results can be considered representative since efforts were made to contact as large a number of individuals affected at present or in future by the stormwater management proposals. One sampling drawback was that, principally for safety reasons, the questionnaire surveys were normally undertaken in daytime. This resulted in a large number of the respondents being women who did not work outside the home. In an effort to balance this trend, surveys also took place in the same areas during weekends when there were equal chances to obtain responses from men and women. The age and gender based analyses carried out and attached in the appendices, did not indicate great differences in attitudes based on gender.

Standard and comparable investigative procedures were followed to ensure the reliability of the research. In addition, special care was taken so that selected sites were representative of their areas. Specific criteria were used at the selection process such as the size of the area and the size and location of the stormwater management scheme. All schemes were located within urban areas of similar characteristics, socio-economic backgrounds, level of aesthetics and function of the systems.

The analysis of the results, presented in chapters 4, 5 & 6, demonstrates the existence of common perceptions between individuals and professionals. At the same time, specific knowledge was gained on certain issues, such as amenity and design features. Information on sensitive issues, such as amenity and safety, resulted from both the quantitative and qualitative approaches while in-depth information on these issues describing the reasons behind any concerns raised, was obtained from the qualitative research. The quantitative methods permitted numerical assessment of other relevant aspects, such as the ranking of different safety hazards and the evaluation of amenity features within urban environments. In this way the two approaches were complementary.

To conclude, the combination of investigative methods was successful in extrapolating valid results. The assessment of attitudes of individuals with conflicting interests was very productive as it generated debates and resulted in a series of recommendations.

4 THE PUBLIC PERCEPTION OF SUDS

"In reality, questioning people is more like trying to catch a particularly elusive fish, by hopefully casting different kinds of bait at different depths, without knowing what goes on beneath the surface"

— Oppenheim, 1992

4.1 INTRODUCTION - STUDY DETAILS

This chapter presents the research details and the results of the first research period (2001-2002) on the assessment of the public perception of SUDS throughout the UK. The research was undertaken as part of the 'social impacts' component of HR Wallingford's DTI PII Project '*Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits*', in cooperation with the Environment Agency (Report SR 622, 2003). Quantitative investigative methods were used in all public perception surveys carried out during this phase.

In 1996 the annual report of the Forth River Purification Board (FRPB) commented that many Scottish rivers have been adversely affected by urban runoff. As a result, SUDS have been adopted for runoff collection and treatment, and the Sustainable Urban Drainage Scottish Working Party (SUDSWP) was formed by SEPA, the Scottish Executive, local authorities, and developers to coordinative roles in the implementation of a SUDS strategy in Scotland (M^{c}Kissock, 2000).

Sustainable Urban Drainage Systems, as components of sustainable construction are required for new developments in Scotland. However, their acceptability by both stakeholders and the public is still debatable and depends on many parameters such as:

- Technical characteristics of the schemes: function, efficiency, maintenance;
- Ecological and biological factors: environmental benefits, creation of new habitats;
- Economic factors: cost of construction and maintenance, SUDS cost in relation to the cost of traditional drainage;
- Amenity issues: creation of amenity areas;
- Social concerns.

Although the use of SUDS in residential areas is increasing, very little research had been conducted to assess the various attitudes towards the systems, or to assess the perception of issues directly relevant to SUDS such as amenity, landscape, restoration and biodiversity. One study investigating the attitudes of stakeholders involved with SUDS, was undertaken in 1998 in Scotland, England, and Wales (M^{c}Kissock et. al., 1999). Another study investigated the public perception of SUDS in Dundee and Dunfermline (Apostolaki et. al., 2001). One of the main outcomes of both surveys was that the level of public awareness and the information provided to householders plays a very important role in formulating public opinion on SUDS and in generating positive thinking towards such systems. Similar surveys have been carried out in U.S.A. (Watershed Protection Techniques, 2000), and Sweden (Hjerpe & Krantz, 2000) and came to similar conclusions. A recent study undertaken by Hyder Consulting on behalf of SEPA, assessed stakeholders' perceptions of SUDS and evaluated the use of guidance on SUDS in Scotland. This study concluded with similar outcomes on the advantages and disadvantages of SUDS as the current research, as well as on matters related to amenity, biodiversity, and safety (Wild et al., 2003).

Consequently, interest has been expressed by developers, consultants and public bodies in determining the public perception of SUDS. This knowledge can eventually help stakeholders to make improvements on SUDS' characteristics and in this way enhance public acceptability.

4.1.1 STUDY OBJECTIVES

During this part of the research the main objective was to assess public awareness and perception of SUDS, particularly retention ponds, in the UK. To address this objective the following sub-objectives were set::

- To assess awareness of general environmental concerns;
- To appraise the importance of several factors in determining public perception:
  - Health and safety issues;
  - Scheme performance;
  - Scheme aesthetics;

- Water Quality;

- To evaluate SUDS within the concept of sustainability by comparing SUDS with other well perceived environmental friendly practices within residential areas;

- To assess the importance of information and education on the specific issue of SUDS in forming public attitudes.

4.1.2 Public Perception Surveys

Twelve sites with SUD schemes were selected in the UK for the overall assessment of public perceptions. A summary of the characteristics of all sites is included in section 4.1.3 and in-depth details are presented in Appendix I-A. Five sites in Scotland were included in the study, two in Dundee and three in Dunfermline. All are served by SUDS systems):

- West Grange and Cala Homes, in Monifieth, Dundee;

- Linburn Pond, Halbeath Pond, Cascade Pond (also known as Pond 6), in Dunfermline.

The Dundee sites had swales, and ponds have been constructed at the Dunfermline sites. Overall, 180 householders in Scotland were questioned. The results from the Scottish sites are presented separately from the English sites as this part of the research preceded that in England.

Seven sites in England were selected for the assessment of public perceptions of SUDS, located within different geographical areas of England. The surveys focused on areas featuring SUDS ponds in the following locations:

- Clayton Le Woods, and Kirkby in Lancashire;

- Coy Pond, and Alder Pond, in Bournemouth;

- Brookfields Park in Worthing, and;

- Emerson's Green and North Common in Gloucestershire.

All sites in England were served by SUDS ponds. Other types of SUDS, notably swales, are not common in England, while the public are often unaware of 'in-ground' SUDS such as permeable pavements and filter drains.

Door-to-door interviewer administered questionnaires with open-ended questions were used, as described in detail in the methodology chapter (section 3.3.2). Attempts were made at each site to reach every house which either had direct access to the pond or was located close enough to ensure that residents were aware of the existence of the pond. However, only about one third of the householders in each location took part in the survey. Roughly half of the householders were not at home, and some of those who answered their doors were unwilling to participate. Second attempts to question householders who were unreachable in the first instance were made at all sites. In total, in each area, the expected response rate of around 60% of householders who were approached agreed to participate in the surveys. Overall, about 400 householders were interviewed at the 7 sites.

4.1.3 Selection of Appropriate Sites

Selection of appropriate sites and the surveying followed experience gained from the previous surveys on public perception of SUDS in Scotland.

The characteristics of the sites selected are summarised in Table 4-1.

Table 4-1 Site characteristics

Sites	Socio-economic class	Size of the area served	Sample Size	Type of SUDS component	Function	Aesthetics
***West Grange*, Dundee**	Medium to upper	120	35	Swales[8]	Flow attenuation	Low
***Cala Homes*, Dundee**	Medium to upper	80	25	Swales	Flow attenuation	Low
***Linburn Pond*, Dunfermline**	Medium to upper	300	60	Ponds	Flow attenuation and water treatment	Medium to upper
***Cascade Pond*, Dunfermline**	Medium to upper	30	10	Ponds	Flow attenuation and water treatment	Medium

[8] Grassed man-made channels allowing small water storage and having the ability to reduce the amount and speed of runoff. Swales consist as the most cost efficient and effective way of water conveyance.

Sites	Socio-economic class	Size of the area served	Sample Size	Type of SUDS component	Function	Aesthetics
***Halbeath Pond*, Dunfermline**	Low, to Medium	260	50	Ponds	Flow attenuation and water treatment	Medium to upper
***Saxon Way*, Kirkby, Lancashire**	Medium	600 Houses	60	Wetland	Flow attenuation and water treatment	Medium
***Lancaster Lane*, Clayton Le Woods, Lancashire**	Medium to upper	200 houses	60	Pond	Flow attenuation	Low
***Brookfields Park*, Worthing Road, Rustington, West Sussex**	Medium to upper	360 houses	60	Detention and Retention pond	Flow attenuation and water treatment	Medium
***Coy Pond*, Bournemouth**	Upper	100 houses	60	Pond	On-line attenuation and treatment	High
***Alder Pond*, Bournemouth**	Medium	150 houses	60	Pond	Attenuation and water storage	High
***North Common*, Gloucestershire**	Medium to Upper	60 houses	40	Pond	Attenuation and treatment	Medium
***Emerson's Green*, Gloucestershire**	Medium to Upper	300 houses	60	3 Linked Retention Ponds	Attenuation and treatment	Medium to upper

Table 4.1 (continued)

4.2 RESULTS

4.2.1 Results from Scottish Sites

Prior to the first perception survey of stakeholders in 1996, little research had assessed the various attitudes of stakeholders involved with SUDS. During that perception survey, questionnaires were distributed to developers, consultants, water authorities, landscape architects, and local authorities with the aim of indicating the knowledge and experience of stakeholders with respect to SUDS.

The main findings of this survey (M^{c}Kissock et. al.,1999) were:

- The main deterrents to using SUDS appeared to be responsibility for adoption and maintenance, and the land take;
- Filter drains and infiltration trenches were the most common constructions amongst SUDS types, while swales were considered to be the least reliable and efficient;
- Regulatory requirements were identified as the major factor in the selection of SUDS. Selection of ponds was additionally based on the need for runoff control and the creation of new habitat;
- According to the opinions of the participants, SUDS were less cost efficient than conventional systems.

The first survey of public perception of SUDS was carried out in Scotland in 2000 (Apostolaki et.al, 2001) with the aim of:

- Gathering information about public knowledge of general environmental issues concerning rainwater management;
- Gathering information about public knowledge of SUDS;
- Assessing opinions about SUDS formed by people who live close to SUDS;
- Comparing public attitudes in regard to different types of SUDS in areas where variable sources of information exist.

Although the majority of participants in this survey were unaware of the term 'swale' and had not been adequately informed about the systems, they were able to indicate the purpose of swales for rainwater collection, avoidance of flooding and replacement of traditional drainage. Avoidance of flooding was seen by 40% to be the major advantage of these systems in the area. Another 40% could not indicate any advantages.

When participants were asked to outline any perceived disadvantages of the swales, around 30% considered them as obstructions for cars and for children. The same percentage thought that grass cutting was a difficult task, and that swales use up space in the garden. However, less than half were aware of their maintenance obligation to their in-garden swales. Awareness of the presence and maintenance of roadside swales was also low. According to the majority of participants the developer should bear the maintenance responsibility, while a small percentage

considered that it should be the city council. Residents thought that the information provided was inadequate, and 85% requested further information on their systems.

Finally, several comments were made with respect to in-garden swales with 35% of participants stating that swales are aesthetically unpleasant, and 25% even characterising them as a nuisance. The comments made with respect to in-garden swales, are shown in Figure 4-1.

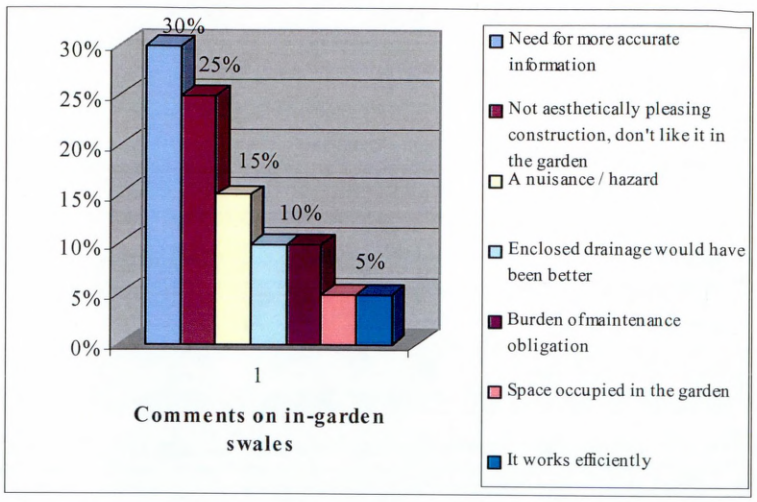


Figure 4-1 Comments on in-garden swales

Many of the householders lived close to roadside swales or to neighbours' swales, but did not have swales on their own properties.

The results of this questionnaire were very similar for the participants served by in-garden swales and those served by roadside swales. Where participants did not have direct access to the swales, they were less willing to participate in the survey and less interested in being further informed. Additionally, they expressed more negative opinions than those served by in-garden swales. 65% stated that swales are aesthetically unpleasant, 37% expressed concerns over safety, another 37% stated that they would not like their house to be served by an in-garden swale and 30% complained about the pavement space taken away by the swales. 20% also characterised swales as a tripping hazard and thought were inappropriate for the area due to the fact that the soil in the area is clay based and any type of water gathering encourages erosion.

Householders living alongside recently constructed SUDS ponds in Dunfermline were also interviewed. The environmental awareness of the residents concerning water pollution, awareness of SUDS, and their opinion on the ponds were all investigated in this questionnaire. Respondents were additionally asked to propose improvements in the area, to outline the information which had been given to them for the sites and to specify by what means they were informed.

The majority of participants were unaware of the destination of rainwater or of their nearest watercourse.

A variety of answers were outlined, indicating everyday activities contributing to water pollution via drains, with car washing being the most frequent response. The responses are shown in Figure 4-2.

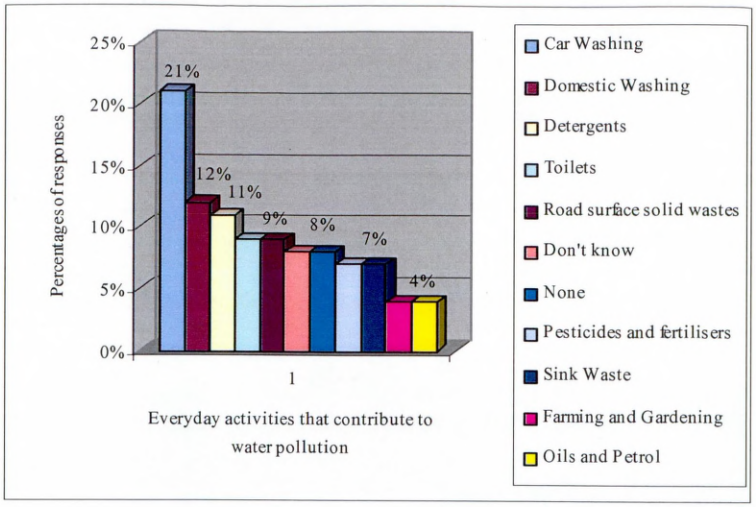


Figure 4-2 Everyday activities contributing to water pollution via surface runoff – residents close to ponds

The majority of participants had poor awareness of SUDS even though they lived across the road from a pond. Awareness was poorer amongst Halbeath Village residents, while the Linburn Pond residents were better informed. The reason for this probably is the fact that the pond in Halbeath Village was constructed alongside an old residential area. In contrast, at Linburn pond, the houses were constructed along with the pond and the residents were informed by the developer about the presence and purpose of the pond before moving into their properties. However, none of the participants were able to outline any different types of SUDS other than their local pond.

The attraction of wildlife, the increase in the aesthetics of the area, and the creation of a new habitat were the main perceived advantages of the ponds, as demonstrated in Figure 4-3.

The majority of participants (70%), expressed concerns over safety issues, with respect to children drowning and characterised safety as the major disadvantage of ponds. All perceived disadvantages are shown in Figure 4-4.

Halbeath village residents in general expressed more negative opinions than the residents of the other Scottish sites.

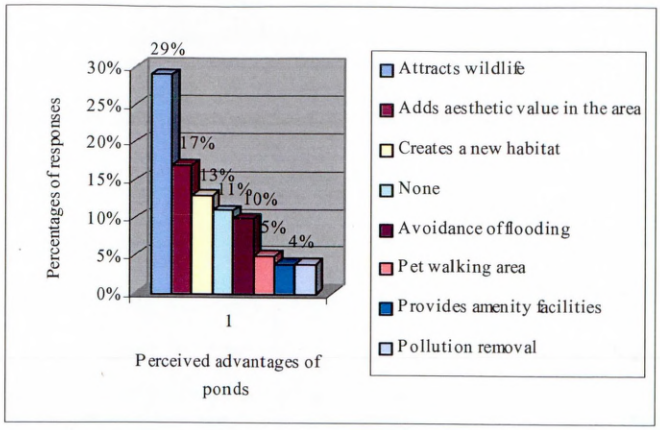


Figure 4-3 Perceived advantages of ponds

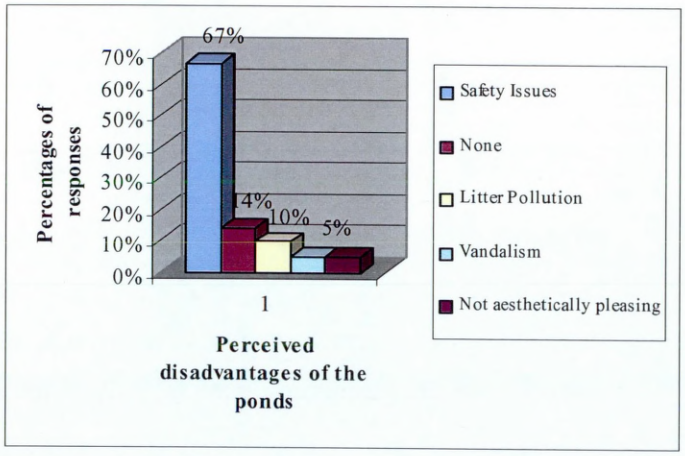


Figure 4-4 Perceived disadvantages of ponds

Various improvements to the ponds were suggested, such as higher fencing, creation of walkways around the pond, introduction of more vegetation and trees, of more wildlife, benches and fish. Awareness of maintenance issues was also found to be lower amongst Halbeath village residents. The majority of the public considered bank-side vegetation maintenance, water sampling for water quality control, and litter removal as the main maintenance activities. There was also a request for provision of more information regarding the local ponds, and the most popular way of informing the public was considered to be leaflet distribution.

4.2.2 Overview of Results from English Sites

Chapter 4 mainly focuses on the results from research undertaken in English sites and specifically in Lancashire, the South Coast, and Gloucestershire. Before moving to the results, it is worth explaining the approach to the presentation of the information obtained. Attitudes towards SUD schemes differ according to site characteristics and pond performance. Opinions about SUD ponds seem to depend on how well established or not the pond is within the residential area. The results tend to be site specific and there are differences in perception at each site. Therefore, analysis of the results on a site by site basis was necessary to identify the parameters influencing public perception. However, histograms of overall results from all sites were drawn, as well as graphs for the separate sites for well-established ponds and newly established ponds. The former graphs demonstrate the general tendencies in perception while the latter show the differences in attitudes between the most positive to the most negative approach respectively.

The overall results are presented in the following section and results from specific sites are included to illustrate the differences in attitudes. Additionally, a basic statistical presentation was used in the bar charts of the overall results. In these charts the ranges within which the average values fluctuate, are presented with lines showing upper and lower limits of percentages of responses at the different sites, from the most positive to the most negative approach respectively. This kind of statistical analysis is not applicable for results per site as the values in these cases are fixed.

In contrast to surveys the US assessing public attitudes towards catchment pollution (Watershed Protection Techniques, 2000), most people asked in these UK surveys (92%) were able to link their everyday activities to potential catchment pollution indicating high levels of perception of water quality issues. On the other hand, there was a lack of public awareness of SUDS as a whole, although most participants where SUDS have been used had formed strong opinions and attitudes about the specific systems within their areas.

Overall, attitudes to SUD ponds were more positive than attitudes to swales. Although the flood prevention function of swales was appreciated, the benefits from SUD ponds were more obvious. The attraction to the ponds of wildlife, the increase in the amenity and recreational value of the surrounding area, the improvement of the landscape, and the environmental way of treating runoff, were all important in producing positive attitudes towards the systems.

The following sections summarise the responses to each question and includes a discussion of the responses to each of the groups of questions separately.

4.2.3 Results per Group of Questions

Environmental Awareness & Concerns

In responses to the question on major public environmental concerns, the participants demonstrated overall low levels of environmental awareness with a high percentage stating that they had no environmental concerns whatsoever. *"I don't have any environmental concerns, my suburb is clean"*. Almost half were unable to indicate the final destination of runoff water. The differences in the responses between the different sites small and are not presented separately.

The major environmental concerns outlined by participants in all sites were air pollution, water pollution, disposal of solid waste and global warming. Some other concerns were also mentioned to a minor degree.

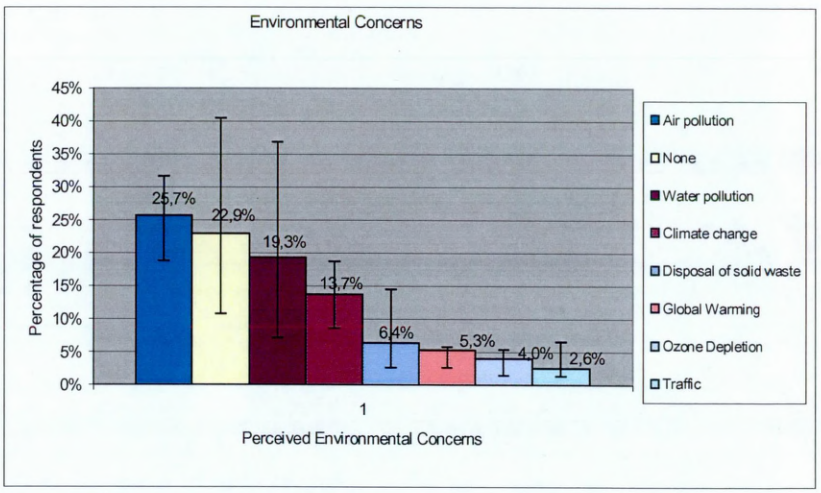


Figure 4-5 Overall Perceived environmental concerns

Some participants were well aware and concerned over environmental issues: *"My major environmental concern? What else but the global environmental issues, the deterioration of the environmental conditions on a global scale: Climate change, ozone depletion, pollution of any kind."*

In Figure 4-5, and in the following graphs of overall results, the bars represent the average percentages from all sites. The maximum and minimum values from the different sites are also shown on each bar.

In all survey sites, the urban environment was perceived by the participants to be the most polluted type of environment. An industrial area was perceived as the second most polluted type of environment to live in.

There were very low levels of awareness of the destination of rainwater at all sites. On average, only about 50% of the participants at each site could indicate a possible rainwater destination.

For the question regarding everyday activities which the participants believed to be the main contributors of catchment pollution via drains, the most frequently mentioned answers included the use of detergents, car washing, domestic washing, disposal of solid waste down the road grids and drains, and toilet waste.

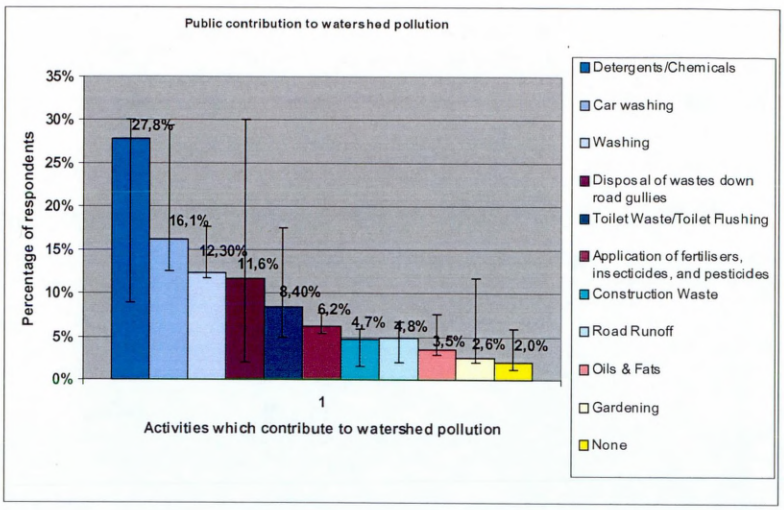


Figure 4-6 Everyday activities that are perceived to contribute to water pollution

However, differences were again identified in the responses of the participants, from those highly concerned over their personal contribution to water pollution to those completely unaware of the result of their activities: *"All our activities contribute to pollution don't they? Form gardening to washing the dishes". "Agriculture contributes more to water pollution than any other activity, the use of fertilisers, pesticides, insecticides". "I cannot tell of any activities as such, don't know"*

Public Awareness of SUDS

Overall, very low levels of awareness of SUDS were identified amongst the participants in all areas. On average, over 90% of the participants in all sites were unaware of the term SUDS. In addition, less than half of those aware of the term SUDS could describe the systems and outline their use. However, most of those respondents could not identify their local pond as a SUD system.

The very low levels of awareness on SUDS related issues could be the result of a combination of reasons:

- the fact that developers and stakeholders do not usually inform householders about the drainage of the area as they either consider it unnecessary or they are not convinced themselves about the advantages of the systems;
- the fact that the systems are not yet widely used;
- the fact that City Councils and Water Authorities do not openly promote the application of SUDS.

Perceptions of SUDS

In the case of ponds, the perceived advantages differ according to site characteristics and are strongly influenced by the aesthetics of the schemes and the amenity benefits the systems provide. In areas with well-established ponds the participants tended to be more positive. In these areas the perceived scheme advantages, as residents perceived them, outweighed the disadvantages. *"It's a great place for walking the dog, for recreation and leisure, we all take care of the plants especially the roses and we feed the ducks. We are worried though, for the ducks trying to cross the road between the pond and the park, they are getting killed by the cars, what a pity"*, *"It is a beautiful spot, the newly-weds are having their photos taken by the pond!"*.

In contrast, with newly established schemes, public perceptions were much more negative: *"What could be the advantages of this muddy hole on the ground? I can see none, on the contrary, it is a hazard for health and it is ugly"*.

Maintenance and cleaning of the water and surroundings of the ponds was a major issue indicating a desire for a clean, tidy and attractive urban environment. Overall, results and differences in perception between an area with a well-established pond and an area with a newly established pond are presented in Figure 4-7, Figure 4-8 & Figure 4-9.

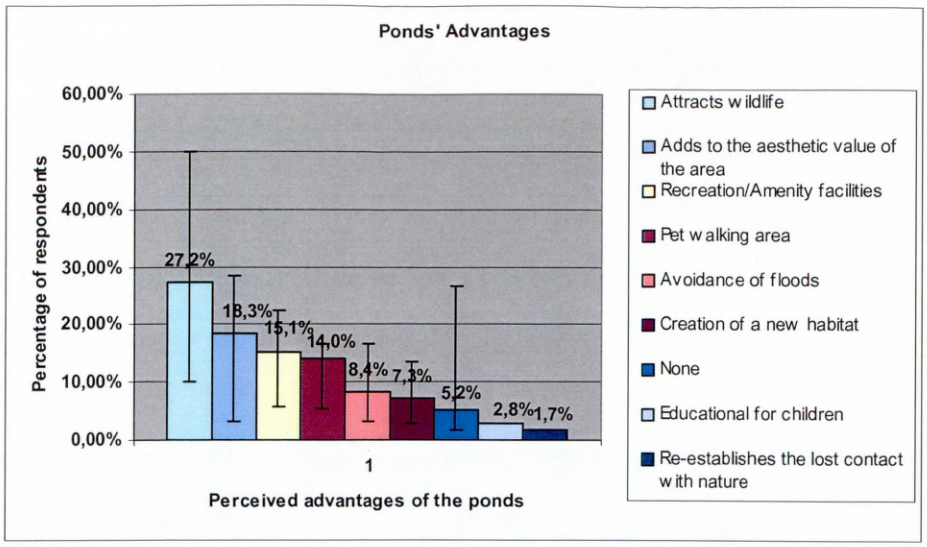


Figure 4-7 Overall results on perceived advantages of the ponds

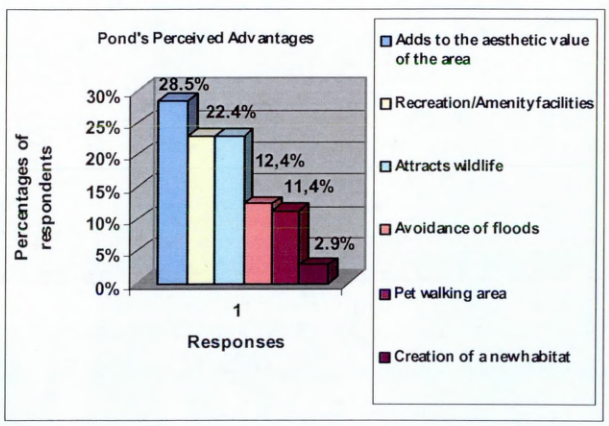


Figure 4-8 Perceived advantages of a well-established pond (Coy Pond, Bournemouth)

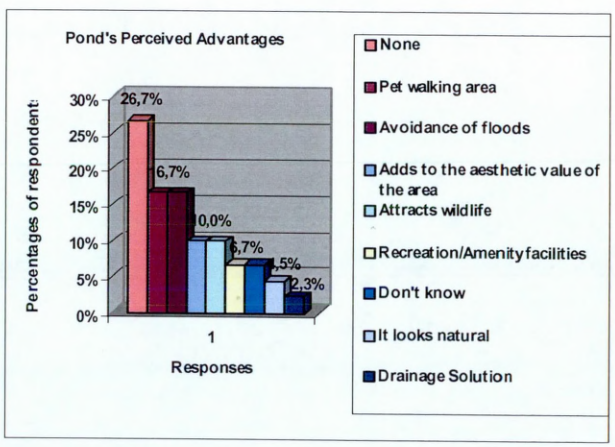


Figure 4-9 Perceived advantages of a newly-established pond (Kirkby, Lancashire)

Safety, and specifically the potential danger of children drowning, was perceived as the main perceived disadvantage of the ponds, especially in newly established schemes *"It is dangerous for children and pets. What if a child falls in the pond are no-one is around?"*.

Clarification was sought as to the relative level of concern of respondents. The evidence indicates that, although safety was the main concern, the degree of concern was also site specific and highly dependent on site characteristics and appearance of the pond. Safety was rarely an issue in areas with well-established ponds. Aesthetic factors seem to play a crucial role in formulating public opinion, even when matters such as safety are involved. In sites with newly established ponds, with little or no marginal vegetation and apparently steeper side slopes, there is potential danger whereas, in well-established ponds with rich marginal

vegetation, access into the water is restricted. Native vegetation, in combination with the wildlife in the pond, makes it appear natural, and this outweighs the potential danger. *"The main disadvantage of the pond is that it attracts a lot of visitors, there is traffic on the road and the noise is a nuisance to us". "It is a poor nesting site for the reproduction of geese and ducks with all this traffic on the road".*

It also worth mentioning that the vast majority of participants who expressed safety concerns (about 85%) still preferred the pond to be located within their residential area, rather than taken out of their local community. It seems that, although there is a perceived safety concern, it is not strong enough to be considered as a deterrent for householders to live close to a SUDS pond. The overall results, as well as the differences in the perceived disadvantages of ponds are shown in Figure 4-10, Figure 4-11 & Figure 4-12.

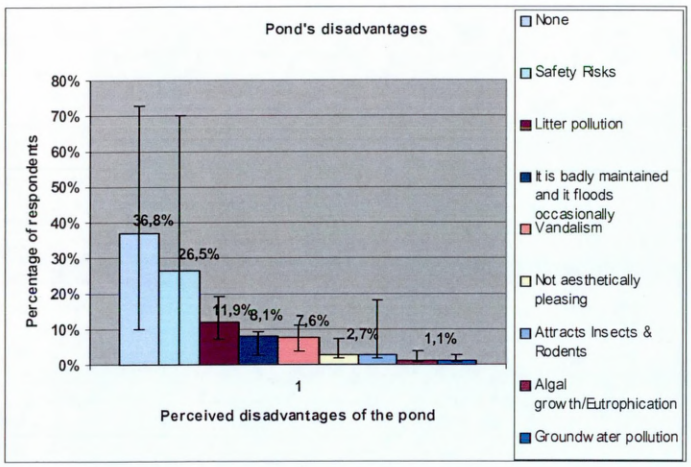


Figure 4-10 Overall results on the perceived disadvantages of the ponds

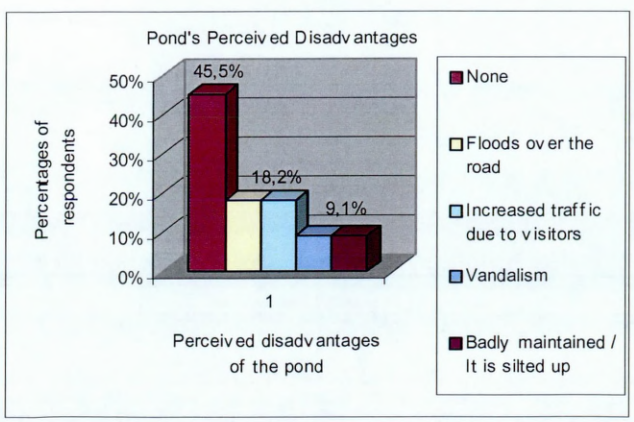


Figure 4-11 Perceived disadvantages of a well-established pond (Coy Pond, Bournemouth)

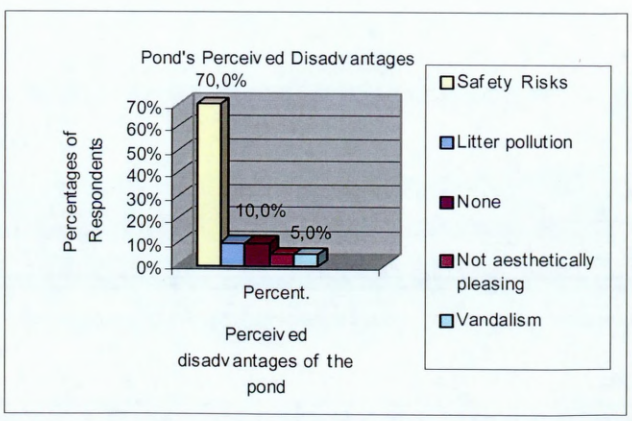


Figure 4-12 Perceived disadvantages of a newly-established pond (Clayton Le Woods, Lancashire)

Safety Concerns

Safety was raised as a primary concern by 70% of respondents in one residential area with a newly established pond. These results were very similar to those from previous surveys on public perception of SUDS in Scotland (Apostolaki et.al., 2001), where similar levels of concern were expressed at an old residential area with a newly established pond. Additionally, in the residential area at Linburn Pond in Scotland - a newly-established but attractive pond within a new residential area - the attitudes towards the pond were very positive. This was also the case at Coy Pond in Bournemouth where there is a well-established and aesthetically pleasing pond within an old residential area. It seems that the degree of attractiveness of the pond can influence perceptions of safety. Even in areas of different social backgrounds people seem to respond similarly to the introduction of ponds with similar characteristics.

The safety concern expressed by the participants in most surveys was the potential for children drowning in the pond. *"I'm concerned about children safety. It gets particularly dangerous in winter when the pond becomes icy. I never leave my children unattended close to the pond".* Despite this safety concern, the vast majority of the participants still preferred to live close to the pond, even having their house looking over it.

When participants were asked to rate the perceived safety risk of their local SUD pond and other safety risks within urban environments the results were similar between the different areas. Although the ratings, given for a major road scheme, a natural pond, a river and a landfill site given were slightly influenced by the aesthetics and the scheme's performance, there were no great differences in overall perception. A busy main road was always considered to be the most dangerous hazard to live close to, while a natural pond and a SUDS pond were classified as the safest features of all.

Particularly in areas with well-established ponds, even those participants concerned over the pond's safety tended to qualify this risk, with 45% rating the SUDS pond as safe enough to live close to. The results overall and from two different areas are given in Figure 4-13, Figure 4-14 & Figure 4-15.

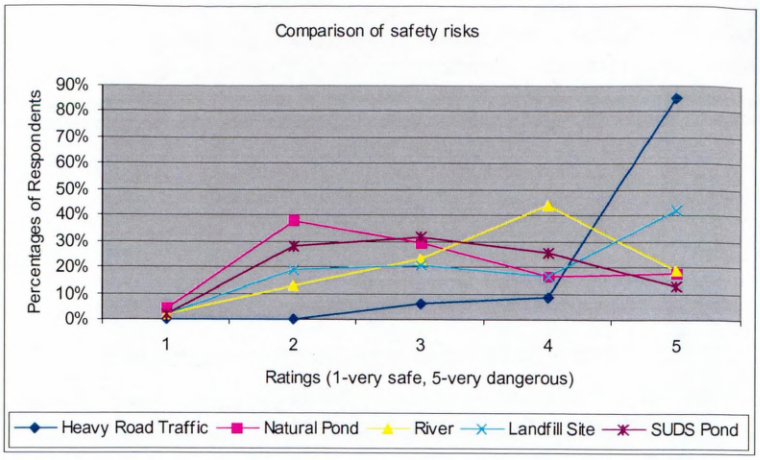


Figure 4-13 Overall results on comparison of safety risks

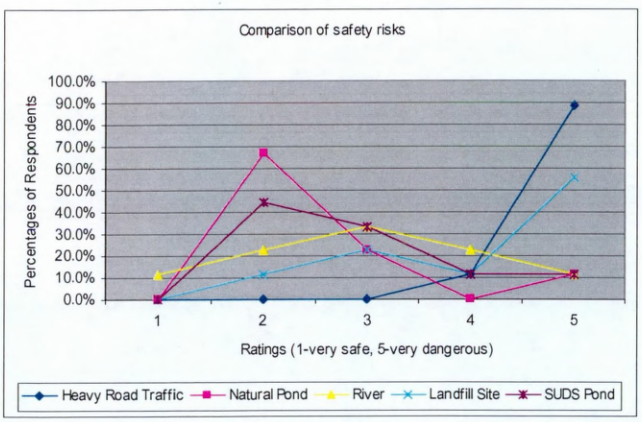


Figure 4-14 Comparison of safety risks in an area with a well-established pond (Emerson's Green, Gloucestershire)

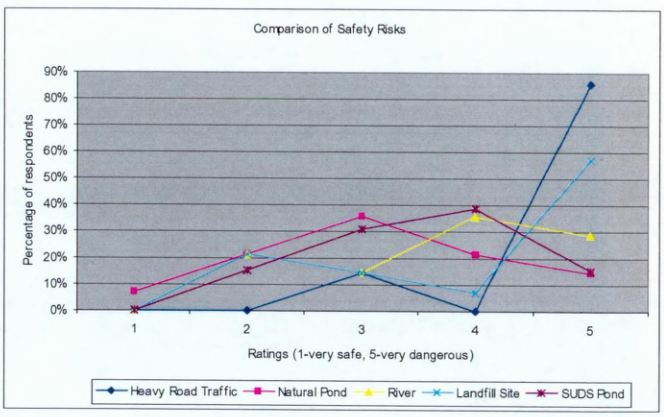


Figure 4-15 Comparison of safety risks in an area with a newly established pond (Clayton Le Woods, Lancashire)

Public suggestions on improving the pond

Several suggestions were made with regard to improving SUDS and these comments were considered to be valid since appearance plays a major role in forming public attitudes. In general, people consider a pond to be aesthetically pleasing when it resembles a natural pond as much as possible and rich marginal vegetation and wildlife are seen as desirable. Additionally, several recommendations are made by householders to improve the surroundings of ponds such as the introduction of benches and picnic tables to serve recreational purposes and the creation of walkways around the pond. The transformation of ponds into amenity

features appears to be increasingly important for local communities. However, the improvements suggested were also site specific.

Maintenance was a major public concern in all areas with SUDS. Litter pollution and silt accumulation in the ponds, were perceived to be the main problems and the tidying up of SUDS ponds and the correct maintenance regime were the main improvements suggested at all sites.

A series of recommendations were made at sites where concerns over safety were high. Shallow side slopes around the pond together with rich marginal vegetation were considered by participants to serve a dual purpose; they act as a safety barrier and also improve the appearance of the pond. Many participants who expressed concerns over safety proposed the introduction of natural barriers around the ponds as a safety precaution which at the same time would improve the appearance of the pond. Warning signs around the pond were also suggested by many householders. However, a number of respondents felt that the introduction of warning signs could have a drawback since they would underline the artificial character of the pond.

The removal of the pond was also suggested at newly built sites or those with low aesthetics. The overall results, and the differences in the improvements for two sites are presented in Figure 4-16, Figure 4-17 & Figure 4-18.

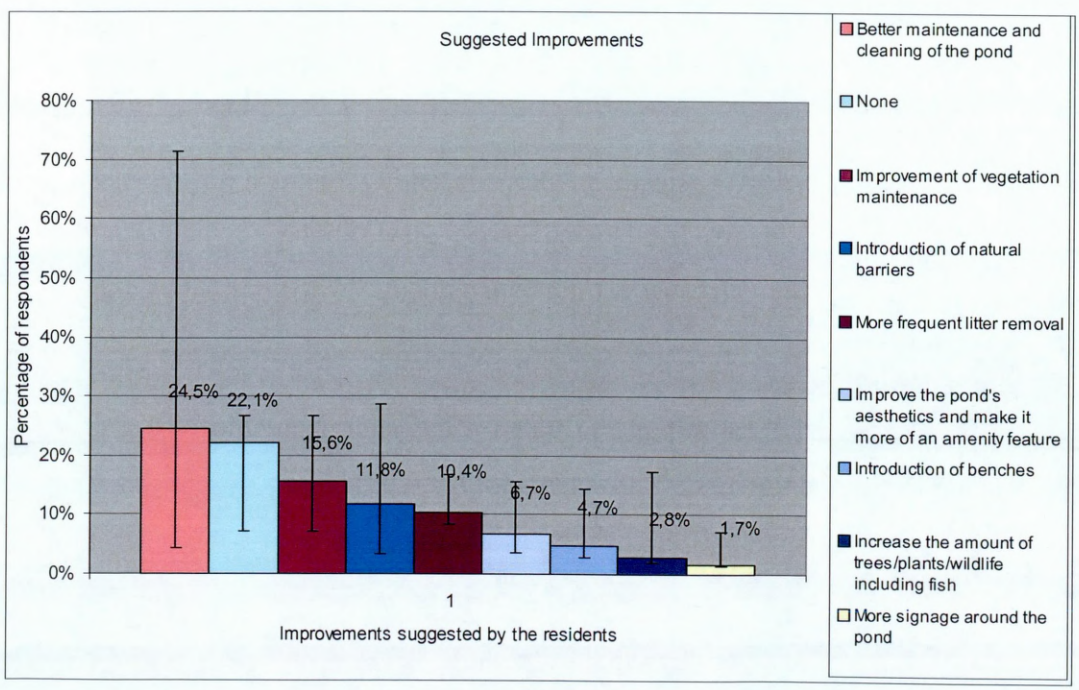


Figure 4-16 Overall suggested improvements

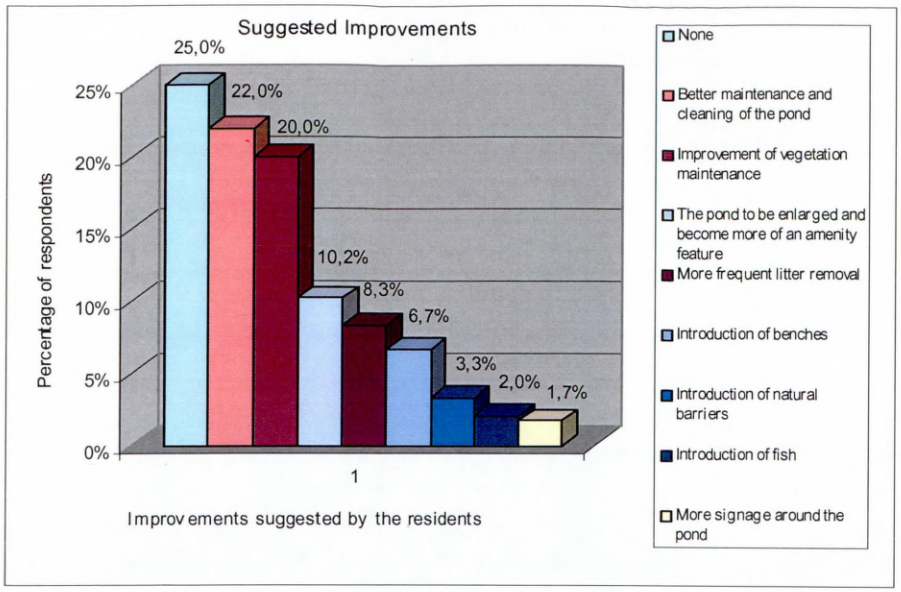


Figure 4-17 Suggested improvements in in an area with a well-established pond (Emerson's Green, Gloucestershire)

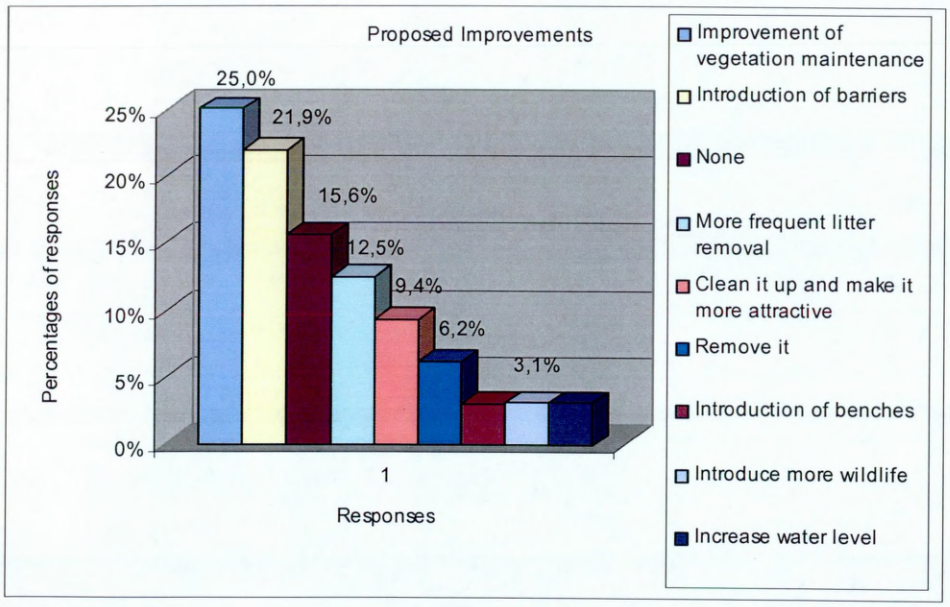


Figure 4-18 Suggested improvements in an area with a newly established pond (Kirkby, Lancashire)

Effect on House Pricing & Saleability

SUDS seem to have an effect on house saleability and on house prices. In areas with well-established ponds, there is perceived belief amongst residents that there is a 10% increase in property value and there is also an increase in saleability. Although house prices are not perceived to be affected by a newly established pond within a residential area, house saleability is considered to be lower. In general, householders are more willing to buy a house

overlooking a well-designed and apparently natural pond. However, an unattractive pond within a residential area puts householders off from buying a house facing the SUDS pond. As a result well-designed and properly maintained SUDS schemes are thought to contribute to an increase in value of a property.

Sustainability of SUDS in relation to other practices

The evaluation of SUDS within the concept of sustainable practices also differs according to site characteristics, as demonstrated in **Error! Reference source not found.Error! Reference source not found.**& Figure 4-20. These Figures demonstrate how participants perceive the sustainability element of SUDS compared to the other types of sustainable practices within urban areas, in matters of economic efficiency, environmental and social benefits.

Error! Reference source not found. shows that, in well-established sites, SUD ponds are ranked at a similarly beneficial level as re-cycling. However, for new ponds, SUDS are the lowest priority.

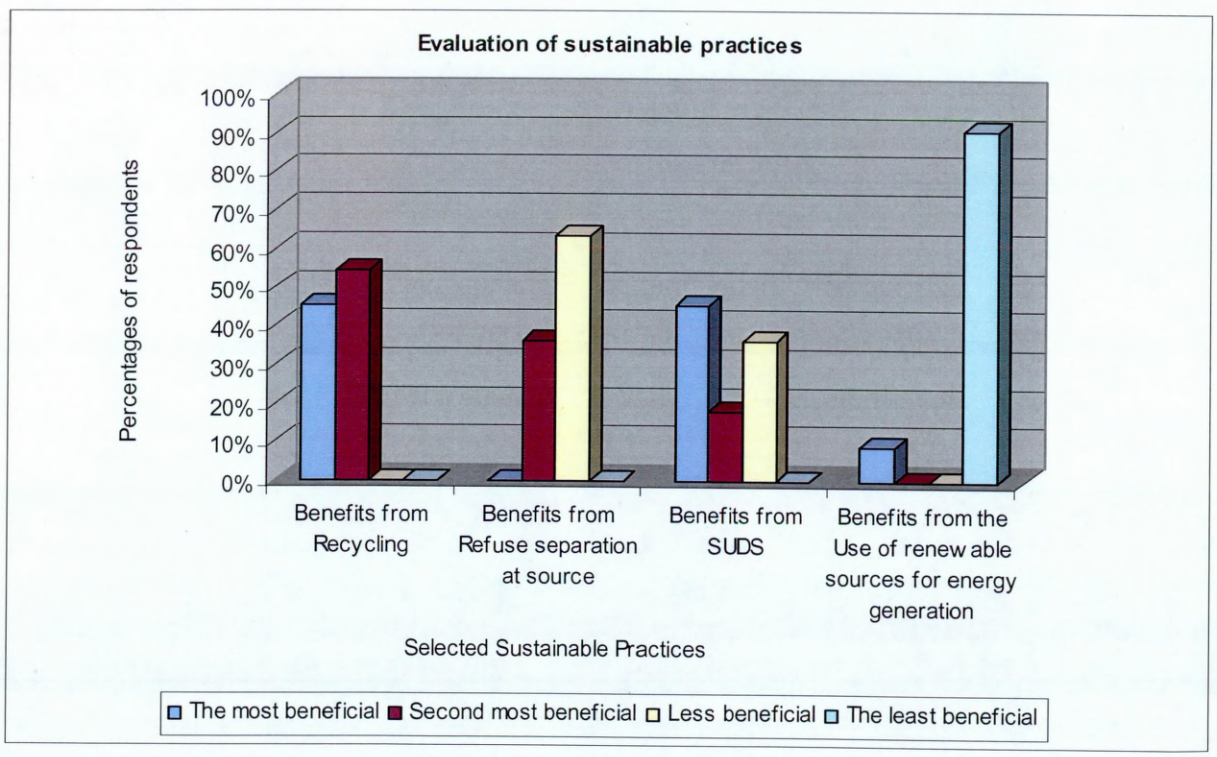


Figure 4-19 Comparison of sustainable practices – Attitudes expressed in an area where a well-established pond is in place (Coy Pond, Bournemouth)

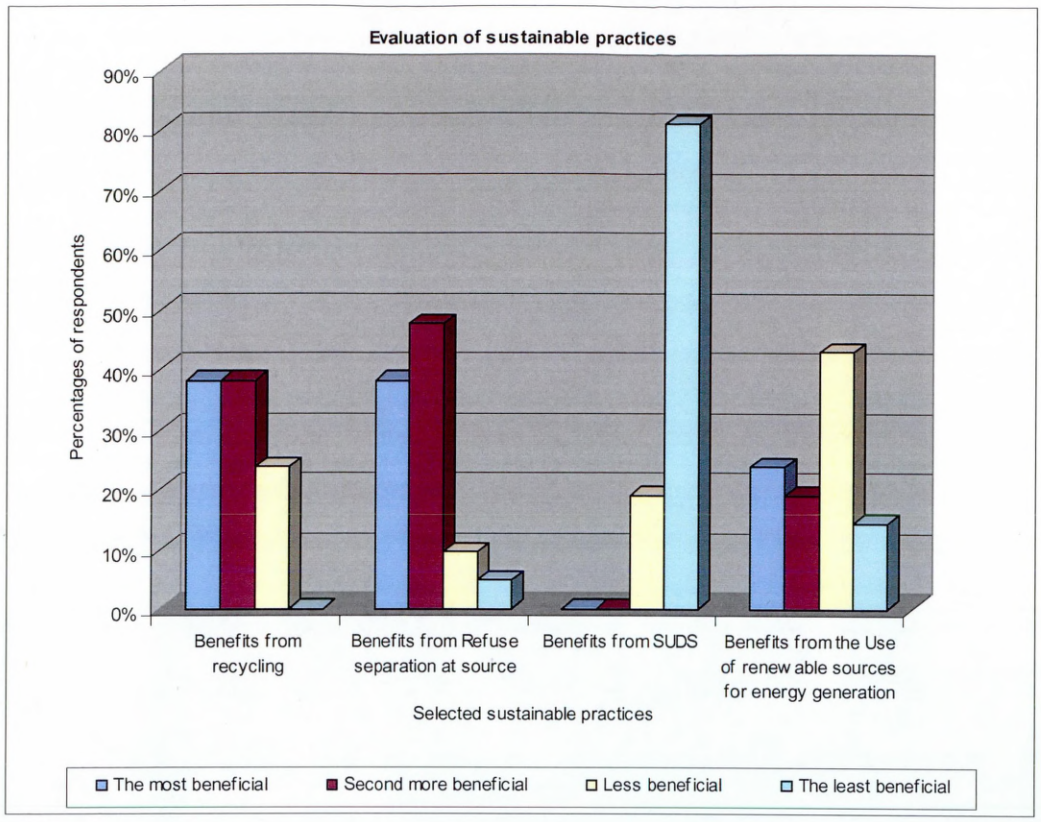


Figure 4-20 Comparison of sustainable practices – Attitudes expressed in an area where a newly established pond is in place (Clayton Le Woods, Lancashire)

Public information and engagement in planning

The research results demonstrate a close link between public information and awareness. In areas where residents were better informed about SUDS-related issues, the overall perception of the systems was much more positive than in areas with little information.

Overall, the majority of the participants (70%) requested information regarding the SUD ponds. They particularly asked for information about the function and efficiency of the systems, the reason for their presence in that particular area and the flora and fauna present. Residents considered the most appropriate method for receiving information would be the distribution of leaflets or newsletters. Participants stated that the developers should have the responsibility of informing householders about the drainage of the area especially where there are above ground structures and should keep them updated about any improvements in the schemes. In areas where there are no active developers the householders indicated that the local council should have this responsibility.

In addition, the vast majority of participants would have liked to have been informed in advance of the construction of the pond and that they would have preferred to have been involved in planning the site. They felt disappointed and neglected for not been asked about what was being constructed in front of their houses. *"They should have asked us about our ideas and expectations of this development; we should have been part of it. It is us, the locals, who have to live with the pond on our doorsteps not the City Council".*

4.3 DISCUSSION

The public, although knowledgeable, did not seem to be as concerned with environmental issues as expected. Although they outlined several environmental problems, indicating a degree of environmental awareness, only a very low percentage of respondents shared those concerns or were aware of the final destination of rainwater. However, the majority of participants could associate their everyday activities to catchment pollution, demonstrating a degree of concern in line with the increasing global trend of environmental protection.

Overall, the awareness of the function and purpose of SUDS was very low. However, perception and attitudes to SUDS were on the whole positive. The main perceived advantages of SUDS ponds were the amenity value of the systems and the attraction of wildlife to ponds. Maintenance and safety issues were the perceived disadvantages of SUDS. Although several concerns such as the function and efficiency of SUDS ponds were raised, the overall attitude towards SUDS was positive. Despite the safety concerns, the vast majority of participants still preferred to live in areas close to SUDS pond.

Table 4-2 Death by Accidents (Selection of Key Data from ROSPA)

Accident	Fatalities
Drowning in lakes, reservoirs and garden ponds (2001)	62
Road accidents (2000)	3409
Accidents in the home	4000
Accidents at work	350

The survey data illustrates the perceived risk from ponds. The statistics in Tables 4-2 to 4.4 are based on information from the Royal Society for the Prevention of Accidents (ROSPA) and provide an indication of the real risk from drowning in SUDS ponds.

Table 4-3 Deaths by Drowning (Key Data from ROSPA, 2001)

Water body type	Percentage of fatalities
Rivers, streams etc	41
Coastal	18
Canals	13
Home baths	7
Lakes and reservoirs	12
Docks and Harbours	3
Swimming Pools	2
Garden Ponds	2
Other	2

Table 4-4 Drowning by Activity (Key Data from ROSPA, 2001)

Activity	Percentage of accidents
Alcohol	35
Fell in	18
Swimming	12
In Vehicles	9
Boating	8
Sub-aqua	7
Angling	6
Playing	4
Canoeing	2
Other	0.4

The ROSPA statistics show that drowning is the third most common cause of accidental death in under 16 year olds. However, the statistics also indicate that the numbers of drownings under the influence of alcohol were greater than the combined statistics for drowning due to falling in, swimming and playing in and around water bodies. Risk is made up of both the probability of an event occurring and the consequences of that event. Since public outrage is an important element for any consequential component of risk, the perception of the risk is as important as the actual risk itself.

Modern new village life with houses situated around a pond or other type of green open space is seen as highly desirable despite the perceived safety risk and is indicative of the shift in perception towards water bodies in urban areas. When asked to compare different safety risks present within residential areas, the respondents classified SUDS ponds and natural ponds as the safest schemes to live close to, while a busy road scheme, a river and a landfill site were deemed as more dangerous.

Most suggestions for improvements were about to improvement to their appearance and perceived safety, both factors which play an important role in forming public opinion and even public perception of matters as important as safety can be influenced by aesthetics. Well-

established ponds are perceived both aesthetically and biologically as being safer than ponds of lower aesthetic value. The fact that the majority of pond improvements suggested were related either to their aesthetics or amenity value can be considered as proof of the role aesthetics and amenity play in increasing public acceptability of new systems. Additionally, in areas with well-established and attractive ponds, SUDS are perceived as equally beneficial for a city as recycling. In contrast, in areas with unattractive ponds, SUDS are deemed as the least beneficial amongst other sustainable actions such as recycling, refuse separation at source and the use of renewable sources of energy.

There is a perceived increase in house prices where they are located close to well-established SUDS ponds and houses are more sellable when they are close to SUDS ponds of high aesthetic value. House owners seem keener to buy houses overlooking a pond which appears to be natural and is rich in wildlife and plant life. The main findings of the surveys on SUDS are summarised in Table 4-5.

Table 4-5 Summary of outcomes

Group of questions	Outcome
Environmental Awareness & Concerns	Low levels of environmental concern
Public Awareness of SUDS	Low levels of awareness of SUDS
Perceptions of SUDS	Positive attitudes where well-established schemes are in place, much more negative attitudes in areas of newly-established ponds with poor landscaping
Safety Concerns	Safety concerns on children drowning, however, such concerns do not discourage people from leaving close to ponds. Ponds perceived as safe as natural. Aesthetics overrun the concern over safety.
Suggested improvements by the public	Suggestions were related to safety and aesthetics
Effect on house pricing and saleability	Potential effect when well-established and maintained schemes are place
Sustainability of SUDS	Responses on perceived sustainability of SUDS highly depend on the level of establishment of the pond
Public Information and engagement in planning	Strong request for the public to be informed and involved in planning

Insufficient information is provided to householders, especially regarding the purpose of SUDS and their need for flood prevention and water treatment. This lack of information is considered as one of the main factors generating negativity towards SUD systems. It seems that

information and the scheme's aesthetics are of major importance in influencing acceptability of innovations within residential areas. Participants who were found to be well informed on SUDS and especially those informed prior to the construction of SUDS in their area, expressed more positive attitudes.

Overall, gender and age-based analysis of the research results showed that there were only small differences in perceptions between genders and among the different age groups. This type of analysis is attached as Appendix I-C, for reference.

4.4 NEXT STEPS IN THE RESEARCH

This research phase indicated that several factors should be taken into consideration prior to designing SUD ponds. The professionals and stakeholders involved with SUDS should take into account the perception of the public of SUDS, public safety concerns, recommendations made by members of the public and the effect of information in forming more positive attitudes towards the systems. On the other hand stakeholder perceptions of SUDS are crucial for the their successful implementation within residential areas since those who are involved in SUDS design and implementation and are responsible for their construction, often maintain and promote SUDS. On this basis, the assessment of stakeholder perception was needed within the framework of this research programme to obtain a clearer picture of attitudes to SUDS and how to enhance their public acceptability in the UK. Professional perceptions of SUDS are assessed and presented in the following chapter 5.

5 PERCEPTION OF PROFESSIONALS INVOLVED WITH SUDS

"We understand participation to be the act of sharing in the formulation of policies and proposals."

— Skeffington, 1969

5.1 INTRODUCTION – STUDY DETAILS

This chapter presents the results of the surveys of the perception of professional of SUDS in the UK. This research phase emerged from the need to obtain a holistic view of attitudes on SUDS and to try to understand the level of professionals' awareness of the needs and likings of the public in relation to SUDS.

The survey work used qualitative investigative methods and was based on a series of interviews and focus groups with developers, planners, design engineers, academics, landscape architects, environment protection officers, water authorities, and local authorities. The questions in the semi-structured interviews and focus groups were grouped by the main issues raised by the public during the public perception surveys in Chapter 4. Interpretation of the combined results of the assessment of public and professional perception of SUDS can be used to draw recommendations on SUDS design and implementation. In turn, this could enhance the acceptability of SUDS within urban environments.

5.1.1 Objectives

The main objective of this research phase was to assess professional perception of SUDS in the UK. Two sub-objectives were set to address this main objective:

- To quantify as well as qualify the professional perception of SUDS;
- To examine the possible effect of SUDS on house pricing and saleability.

Professional perception of SUDS was assessed in relation to the following issues:

- Amenity;

- Biodiversity;
- Safety;
- Design characteristics;
- Barriers to SUDS application.

5.1.2 Application

Two methods were used to address the objectives of this stage of research:

- Sixty semi-structured interviews with professionals to gather both quantitative and qualitative data;
- Three Focus Groups, which served the double purpose of gathering in-depth information on the issues brought up during the interviews and generate debate and also testing the validity of interview results.

The face-to-face semi-structured interviews with professionals involved with SUDS were undertaken between March and June 2003. The interview technique was to use open-ended questions on matters of amenity, biodiversity, safety concerns, design characteristics of SUDS, possible effect on house pricing and saleability as well as barriers to SUDS application.

The participants in the survey belonged to the following professions: design engineers, landscape architects, environment protection officers, planners, employees of water & local authorities, developers, and researchers and academics working on SUDS related issues. Estate agents were also interviewed to determine the possible effect of SUDS on house pricing and saleability.

The same format of topics/issues was also raised in the Focus Groups. Discussions were tape recorded, with interviewees' permission, transcribed and analysed by the researcher.

The focus groups were as follows:

a. The first Focus Group was at Aberdeenshire Council on 20 May 2003. The participants consisted of one member of the council (a design engineer) and catchment planners working in

SEPA's planning department in Aberdeen. They were all currently involved in SUDS related projects in Aberdeenshire.

b. The second Focus Group was on 5 June 2003, in the Urban Water Technology Centre of the University of Abertay Dundee and was with academic researchers whose main research interest was SUDS. The background of the researchers varied and included engineers and scientists who are all working on different project related to SUDS performance, design, cost and maintenance issues, as well as social issues.

c. The third Focus Group was on 9 June 2003 in the offices of the Scottish Environment Protection Agency (SEPA) in Riccarton, Edinburgh. This focus group was with environmental protection officers (EPOs) working for SEPA.

5.2 RESULTS

5.2.1 Overview of Results

Even though the results of the focus groups and semi-structured interviews are in agreement on many issues, they are presented separately. The main reason is that the similarities in responses received during the semi-structured interviews can be quantified whilst results from the focus groups cannot be quantified in the same way. This enabled both quantitative and qualitative analysis of the results.

Overall, the amenity of SUDS was considered by the interviewees and the focus groups to be of high value if they are constructed and maintained according to design recommendations. Most participants underlined the acceptability of any structure with predominantly natural features.

To the professionals, the term amenity includes ideas such as visual and habitat enhancement; wildlife and biodiversity benefits; the provision of an urban park environment for recreation, relaxation, and leisure; a stress relieving area; educational benefits; and areas of high aesthetic value. If SUDS are designed with amenity and biodiversity in mind they can be integrated into the local landscape.

Safety was not a concern for most of the professionals, who believe safety to be a matter of perception rather than actual risk. Design characteristics play a very important role in public

acceptability, while the main barriers to SUDS are maintenance, planning and land take. The professionals did not seem to worry about the public attitude towards SUDS as they believe this barrier can be easily lifted with proper public information. It is concluded that, if SUDS do not interfere with the natural environment or if they are designed to look as natural as possible, they are welcomed not only by professionals but also by the public.

5.2.2 Semi-Structured Interviews Results - Results per Group of Questions

A decade ago the idea of placing a pond within a housing development would have been immediately rejected. However, the perception of professionals is changing towards the introduction of water-bodies within residential areas. These changes follow changes in general perception, in landscape & planning ideas and an increasing need for contact with nature.

The semi-structured interviews demonstrated a variety of opinions which are presented in this chapter but the results demonstrate similarities which provide the basis for sound quantitative analysis. The quantitative analysis of the semi-structured interviews helped to form a clearer idea about trends in attitudes towards SUDS and related issues, while the qualitative analysis helped to obtain a better understanding of the perceptions of the professional. A thematic interpretation of the two types of results follows.

Amenity

All respondents could identify the amenity value of SUD schemes. Most believed that SUDS are of high value if they are constructed and maintained according to the design requirements. Unfortunately this is not always true for contracting or maintenance companies building and maintaining SUDS.

The public preference for structures with a natural appearance was underlined by the majority of participants. Consequently, if SUDS are in harmony with the natural environment or if they are designed to look as natural as possible, they are welcomed not only by professionals but also by the public.

According to the professionals, the term amenity includes ideas such as visual and habitat enhancement; wildlife and biodiversity benefits; the provision of an urban park environment for recreation, relaxation, and leisure; a stress relieving area; educational benefits; and an area of high aesthetic value. *"If SUDS are designed with amenity in mind they become part of the*

community persona and the landscape. Then the public tends to appreciate the area and to use it for recreation and leisure" (male from Water Authority). A quantitive analysis of the responses is shown in Figure 5-1.

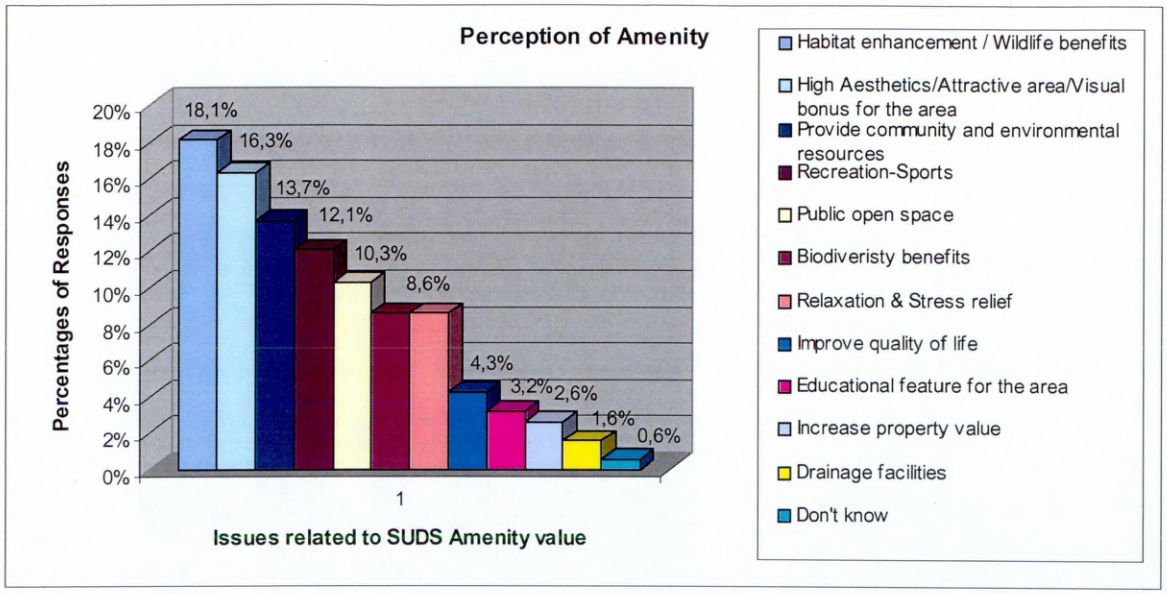


Figure 5-1 Perception of Amenity by professionals

Equal numbers of participants (about 40%) believed either that the amenity value of SUDS schemes is not valued at all by the public or that it is valued only in cases of well designed and aesthetically pleasing systems. *"High or low, the appreciation of SUDS amenity depends on the quality of the design. It depends on where the balance of the argument is, flood prevention, amenity, or attenuation. SUDS are often designed without amenity and education in mind"* (female – researcher). People only widely use the best examples of SUDS ponds or wetlands for recreation and leisure and they specifically appreciate wildlife in the ponds. *"If people didn't realise SUD systems were constructed they would use them widely. The answer hides in the naturalness of the systems"* (male - EPO). However, 20% of participants believed that the the amenity value of SUDS schemes is recognised by the public regardless of the maturity of the scheme. The fact that ponds are often used by children as play areas and that many people ask for fish to be introduced in the ponds are evidence of the amenity value of the systems. *"An indicator of amenity appreciation is the fact that people ask for fish to be introduced to ponds"* (male - design engineer). However, this attitude is not prevalent in schemes with low amenity value.

Biodiversity

The vast majority of respondents (70%) believed that SUDS have the potential to be beneficial to biodiversity since they create new habitats within urban areas. They believed that SUDS ponds and wetlands have obvious biodiversity benefits, while another 23% believed there is only limited biodiversity and that is in mature, biologically effective systems. One male researcher said: *"Correctly designed and well-built systems enhance biodiversity. However, more than half of the systems are not properly designed so they end up been of not huge benefit to biodiversity". "SUDS create natural habitats. Artificial habitats are more important today that natural habitats are lost"* (male - EPO). Only a small percentage, (just 7%) did not perceive SUD systems to be of any benefit to biodiversity whatsoever.

When questioned about the biodiversity benefit as perceived by the public, most respondents (35%) believed that the public has no appreciation of the biodiversity in SUDS; 30% believed that a biodiversity benefit is highly appreciated when it is obvious; another 25% believed the public is completely indifferent to these kinds of issues. The overall perception is that most people tend to focus on aesthetics and amenity rather than on the biodiversity potential or value of the systems. One female EPO stressed that *"People would appreciate it more if they would have been able to walk around the pond. The key is encouragement to get closer to water and overcome the possible fears related to water bodies".*

> *"The public appreciates appearances only. Even the biodiversity appreciation is mainly linked to visual benefits; it looks nice to have wildlife and plantlife around!!! People usually prefer ornamental surrounding in a pond. People of higher socio-economic and educational background tend to prefer wild-natural looking pond surroundings"* (male from Water Authority).

The public associates biodiversity with certain animal species, mainly birds and dragonflies, and not with plants and small insects. Consequently, unless certain species are found in SUDS, people are unaware of the biodiversity benefit of SUDS.

Safety Concerns

The majority of professionals (just under 50%) believed that there is a perceived rather than an actual safety risk, provided that the SUDS ponds are designed with safety in mind and that they are not located near airports (risk reduction of bird strikes). A male EPO commented: "*Provided there has been a proper drainage impact assessment taking into account the*

flooding risk from rising groundwater, SUDS schemes are safe to be located close to houses". Just over 35% of participants considered ponds and wetlands safe in almost all cases. However, people show great concern over safety since SUDS are a new idea with new types of structures which are not well promoted.

Under 10% of interviewees believed that SUDS schemes are not safe enough to be located close to houses. People tend to fear watercourses in urban areas not only because of the actual risk but also for psychological reasons.

> *"There is a Health & Safety issue involved with SUDS. There is danger for children who are always attracted by water. Artificial watercourse works as a magnet for children more than natural watercourses. Natural ponds are not so close to houses, houses are not built right in front of natural ponds as they are in front of SUD ponds"* (female - EPO).

Education of the public and especially children concerning behaviour close to watercourses, in combination with proper design of systems could be the solution to public acceptability of the schemes.

Planning departments also have real concerns over safety from drowning and from the thin ice covering ponds in winter. They are specifically concerned about the nuisance and responsibility in cases of accidents. However, to summarise a few participants from planning departments: "*In the case of road accidents there is no responsibility for the council, road department or any other authority, it is the person's responsibility to be careful*". The same respondents believed that this should also apply to SUDS as long as they are designed properly to current standards. They should be treated as public features where everyone has a personal responsibility.

The professionals made several suggestions to promote the safety of SUD ponds and wetlands,. Recommendations included the creation of natural barriers around the ponds using rich vegetation (27%), shallow pond side slopes (around 25%), education of the public (just less than 20%), and shallow water level within the pond (12%). *"Introduction of Reed beds around the ponds, no signage. Reed beds serve a triple purpose: they are aesthetically pleasing, they consist as a natural barrier for children to reach water, and they provide pollution removal"* (male - design engineer). All answers are presented in Figure 5-2.

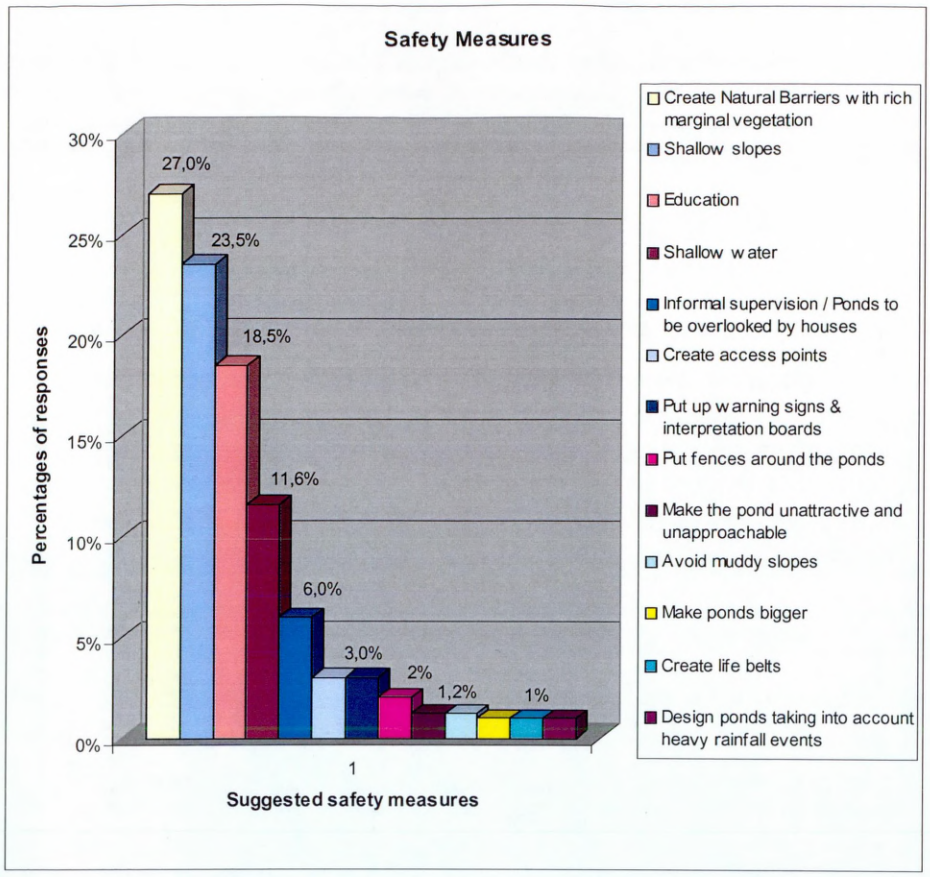


Figure 5-2 Suggested safety measures by professionals

The vast majority of participants (82%) were unaware of any public reports regarding safety. All the complaints mentioned by the remaining 18% of participants related to concerns over the potential for children drowning. These concerns were mainly in areas where families with young children lived close to a pond, or where a pond was perceived as dangerous due to its design (for example, steep side slopes, lack of marginal vegetation etc).

Professional Suggestions on Design Characteristics

The vast majority of respondents (also 88%) believed that changes in the design of SUDS could influence public acceptability. However, the remaining 12% believed that SUDS ponds will never be acceptable even if the design is improved.

Several design-related suggestions were made to enhance public acceptability of SUDS schemes, most being related to safety. These include the use of soft engineering practices (shallow side slopes, non-deep water, safe access to water), and the notice boards to inform the public on water depth. Informal supervision at ponds was also suggested by many professionals as a measure which would reduce the risk of drowning. Natural barriers were

often suggested as safety measures but also as an improvement of amenity and biodiversity and for pollution removal. The responses are presented in Figure 5-3.

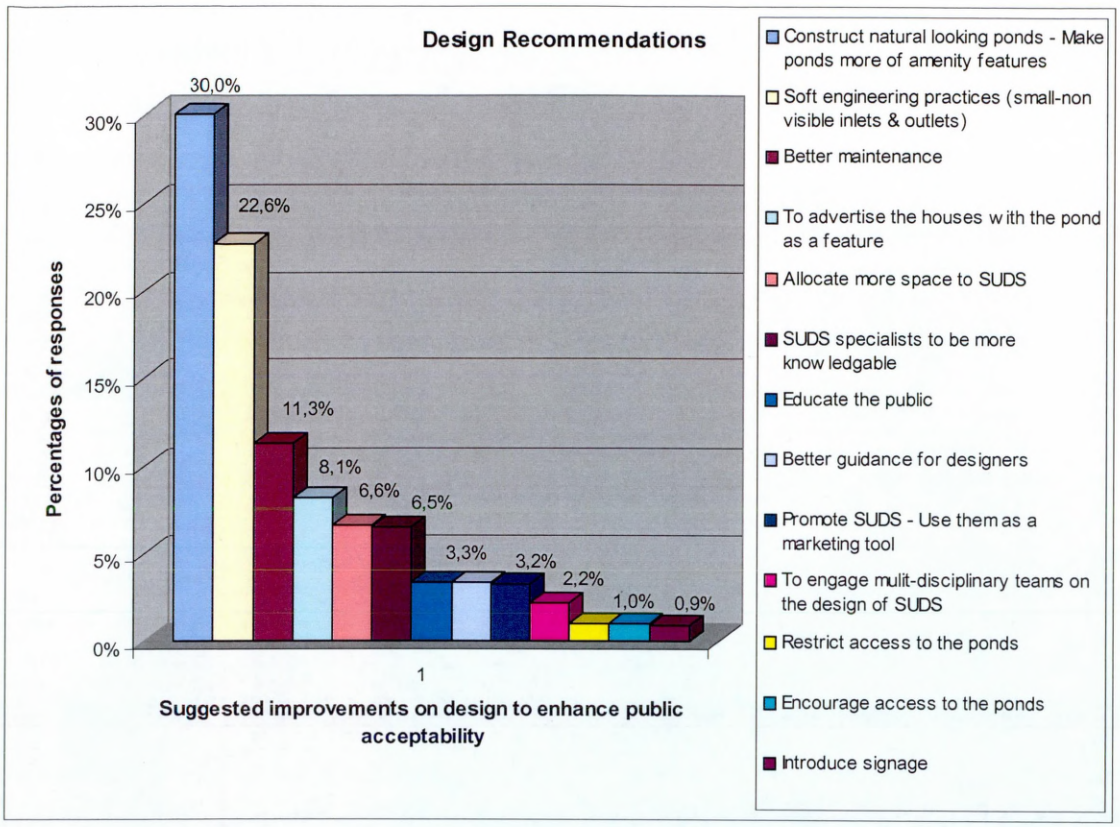


Figure 5-3 Design Recommendations to enhance public acceptability of SUDS

The appearance of systems should also be improved and the most frequently proposed method is through landscaping which appears to be natural. This should be taken into consideration at the design phase and not after their construction. This would not only achieve better aesthetic and biological results but should also reduce construction costs. One example is at Monifieth in Scotland, where SUDS were installed construction of the development. In this case no space was available for swales, resulting in the construction of large ugly swales the gardens of private properties. The result was ugly and the maintenance responsibility of the householders put off future potential house buyers. As a female researcher said: "*If SUDS are properly designed and incorporated in the plan from the very beginning, if they are properly landscaped, put in the right place and are well established, they can increase public acceptability and reduce the safety concerns*".

Special care should be taken at the design stage to ensure that the areas served by SUDS are properly drained, that they function correctly and are properly maintained. If new systems are

maintained properly, local residents tend to appreciate their value in their area and protect them from vandalism.

The location of SUDS within the development also plays a very important role for their acceptability both by developers and the public. Many believed that SUDS ponds should be located within the open green space of a housing development, and not in front of houses, on doorsteps or on contaminated land, which can cause groundwater pollution. "*If ponds are integrated in the development, and people often come across the pond, then they see it and realise its use and benefits*" (male - planner)

Appropriate guidance and detailed design information was mentioned by many participants as a key issue needed to improve SUDS design. It was suggested that the new SUDS design manual should be available at low cost, or even free of charge to ensure its use by all engineers involved with SUDS. Additionally, better data collection could ensure better SUDS design.

> "*A common problem in SUDS construction is the fact that most of the design data comes from the U.S.A. where rainfall events and ground conditions are different than in UK, resulting in designing oversized SUDS. Data collection in UK is a necessity for successful SUDS application in U.K*" (male - researcher).

Effect on House Pricing & Saleability

When questioned about the possible effect of SUDS on house pricing and saleability over half of the respondents (55%) believed SUDS to have a positive effect on both house prices and saleability. The positive effect appears to be an increase of around £2,000 for a house valued at around £150,000, or 1.3% of the overall price. However, this is more likely when houses are resold and not when they are first bought. A common perception from participants was that the prices of houses within a development are originally priced according to the size of the house. However, when properties are resold, houses that overlook SUD ponds and wetlands are sold at higher prices than other properties at a distance from the SUDS pond or wetland.

27% of participants believed that SUDS could have either a positive or a negative effect on house prices and saleability depending on their design, operation and appearance. If SUDS are promoted and look nice, people may be willing to pay more.

> *"People would definitely prefer a house that overlooks a nice pond or any other kind of amenity feature (i.e. garage, garden, open space, pond). In general a house will be more desirable near water, therefore, a well designed and maintained pond or wetland would be beneficial in matters of property value"* (female - landscape architect).

Porous paving, infiltration trenches and some swales have no obvious attraction to a house purchaser although to some the 'environmental benefit' may appeal. The buyer would need to be persuaded that such systems on private property would be well maintained or that they are easy to maintain.

The financial value of properties is reduced when the SUDS are badly designed and inappropriately maintained. One participant, a male academic with an engineering background was very concerned over insurance problem related with SUDS. He observed that insurance companies refuse to insure houses that are close to any kind of watercourse.

> *"Insurance costs for properties in flood hazard areas or near ponds or watercourses have increased by around 250% on average so far, and will continue to increase dramatically until 2007 when cover may be withdrawn altogether in such areas. Properties constructed after 2001 will be more at risk of groundwater flooding due to level access requirements, and flooding from rising groundwater is specifically excluded from insurance cover".*

Barriers to SUDS Implementation

Many reasons are barriers to the use of SUDS. The participants indicated that the main barrier is adoption and maintenance (20%). In many cases responsibility for maintenance is unclear and there is disagreement between water authorities, road departments, city councils, and developers on adoption and maintenance of SUDS. This discourages developers from incorporating SUDS into new housing schemes.

The negative perception of SUDS by developers and planners (around 20%) and land take (17.5%), appear to be major issues for developers. Lack of knowledge and appropriate training within the SUDS experts (15%) were also mentioned. All barriers outlined are presented in Figure 5-4.

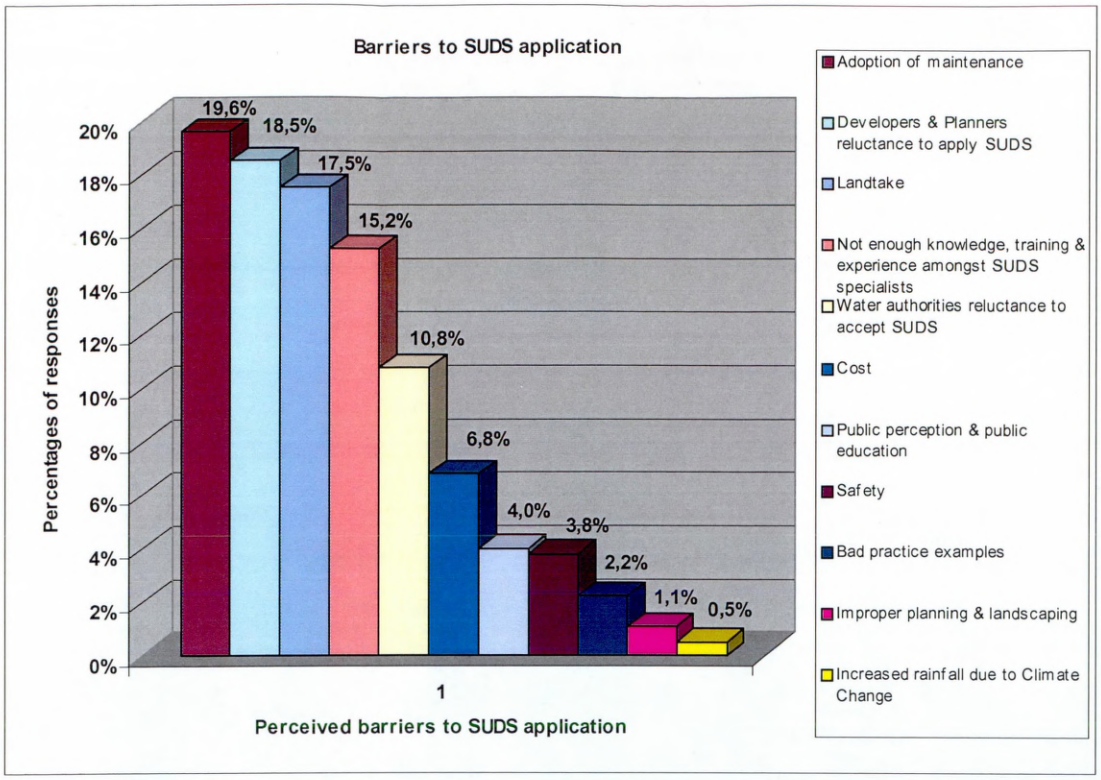


Figure 5-4 Barriers to SUDS application

One of the main barriers indicated by participants is land take. Developers have considerable concerns about the space required for SUDS and the financial implications of including SUDS within a housing development. Even a potential increase in house prices would have been so low that it would not compensate for the money lost from giving up the land for the SUDS. This issue is most acute for above ground SUDS, especially ponds and wetlands but is not so critical for smaller scale or below ground systems. Underground SUDS are preferred by developers and the public because of the reduced land take. If they do not see the systems, then there are also no perceived danger from them. However, above ground systems generally perform better because pollution is visible, maintenance is easier, and there is avoidance of pipe blockages. In addition to having easier maintenance, the main argument in favour of above ground systems focuses on amenity and landscaping. However, these issues are important for planners but not for developers. Underground systems can be good for flow attenuation, stormwater control & pollution removal, considerations of importance for drainage authorities. However, SUDS should also be designed with landscaping and sustainability in mind, i.e. benefits to the hydrological cycle and benefits for climate change.

> *"Developers tend to squeeze SUDS at the back of the development, in a piece of land that they couldn't use for any other purpose. As SUDS are often placed at the back, next to the river, are not flood prevent. When the river overflows the SUD pond floods immediately and does not serve the flood prevention purpose"* (male - landscape architect).

Some participants believed that SUDS have the advantage that more water often ends up in local streams. They stated that water is gathered both above ground in ponds or wetlands or in underground chambers and is led to the local streams through the SUDS outlets, increasing the water volume to the stream.

Additionally, with current climatic change predictions and a predicted increase in rainfall, estimated to be up to 30% in some areas, SUDS may be considered as inadequate to deal with the excessive amounts of water. To deal with this problem there is a move to begin designing SUDS for a 200-year event capacity. Water service companies, responsible for storm drainage, and the Rivers Agency, responsible for flood defence, are completely against SUDS with the excuse that SUDS, as they are designed today "*cause flooding*". The tradition of urban drainage engineering in the UK is that all water should be removed immediately and should be contained in engineered conduits. There is the perception that traditional engineering is very conservative and there appears to be a lack of understanding that SUDS in urban areas are being built "*to prevent flooding*".

Education of the public is another barrier to SUDS use. The public perception surveys and the professional attitudes survey showed that members of the public who are educated in SUDS tend to be more positive about SUDS within their residential area. However, in reality, there is very limited public awareness of SUDS and this creates a barrier to implementing a SUDS strategy. Developers often fear that public negativity towards SUDS could affect saleability or house pricing although the reverse is true provided certain conditions are met. This means that the promotion of SUDS as a sustainable practice is crucial for their acceptability and wider adoption.

Besides convincing the public and developers to accept and adopt SUDS, planners, water authorities, and city council also have to be convinced. SEPA has a policy of promoting SUDS and having SUDS incorporated into new developments. However, at the end of the day planners and water authorities have to make the final decision. The principal concern of planners surrounding SUDS are land take issues, and water authorities are concerned with

maintenance and how to satisfy city council demands. Local authorities are also normally reluctant to incorporate an open water body such as a pond within public open space, although this may be the best solution for a given situation.

Another significant barrier is the lack of expertise on SUDS, lack of clear guidance and consistency, and lack of training amongst professionals involved with SUDS systems. The CIRIA manual is considered by many to be an inadequate design guide, and the existing training courses were doomed by some professionals to be too general without providing sufficient technical knowledge for design. A common opinion amongst professionals, especially engineers, was the importance of setting standards for SUDS construction.

> *"There should also be standards set for the adoption of SUDS. A mechanism should be found to ensure that when a developer finishes a site, all elements are finished at the same level and are all fully operational. It is a Technical Authority's responsibility to secure proper use of the instructions and technical details"* (male - design engineer).

Ground conditions are also very important for SUDS acceptability since not all SUDS options are suitable for all ground conditions. Failure to understand which system is appropriate for each area could be a barrier to success. Where the soil is impermeable, clay or heavily compacted soil, soakways are not suitable as they could block and overflow. In brown field sites, where the soil is contaminated, SUDS could cause groundwater pollution and soakways again are not recommended. Wrong SUDS componentns, apart from causing serious problems with excessive rainwater running off the site could also lead to serious liability concerns for insurers who might withdraw cover.

The aforementioned refusal of insurers to cover houses close to watercourses was underlined by one of the participants (male - academic) as a major barrier in SUDS application. As he explained:

> *"...it is quite possible that in the future insurance companies may decide to exclude liability arising from SUDS features in householders' gardens in the standard household policy. SUDS could result in higher water tables and rising groundwater. This is not covered under a standard household insurance policy, and mortgage lenders may decide not to accept such properties as collateral, a fact that can affect negatively the saleability of houses located close to SUDS".*

5.2.3 Profession-Based Analysis from the Semi-Structured Interviews

At this point it is interesting to try to identify differences in perception and attitudes amongst the different professions of the participants. Many answers appeared to be influenced by personal experience, knowledge, and interest. Although there were no important differences in perception of the amenity concept or on biodiversity issues, there were differences in responses to the other categories of questions.

Developers seemed to be more concerned about safety than other professionals, 50% stating that they believe SUDS are not safe enough to be located close to houses. This response was different from other professionals who considered SUDS ponds and wetlands safe enough to be located within residential areas. A profession-based analysis of the results in the question about whether professionals consider SUDS as safe or not, is presented in Figure 5-5.

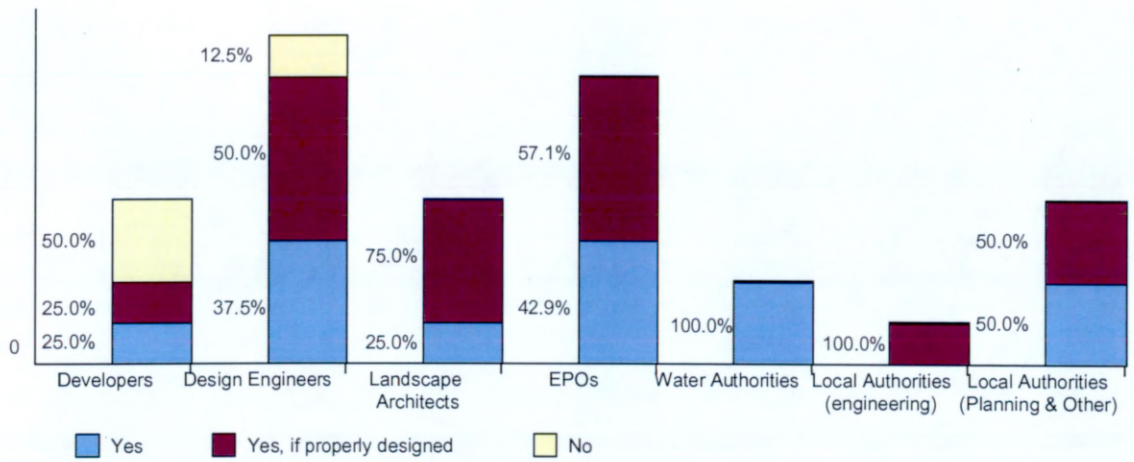


Figure 5-5 Profession-based safety concerns

Different design changes were also proposed depending on the profession of the respondents as indicated in Figure 5-6. A wider variety of suggestions were made by design engineers and EPOs, whilst developers proposed public information as the only means of enhancing acceptability of the schemes.

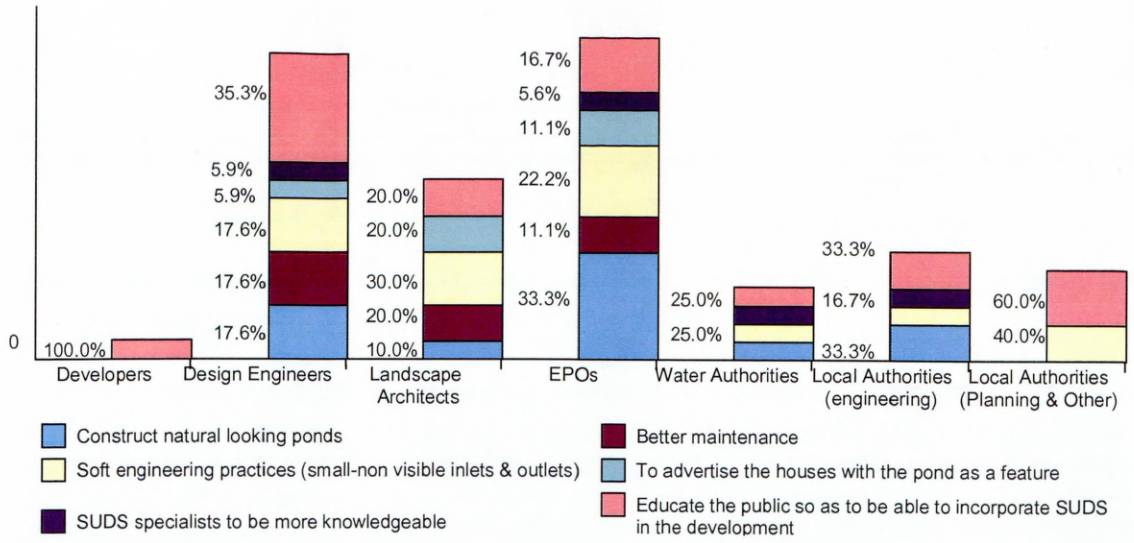


Figure 5-6 Profession-based design amendments

The vast majority of developers who were mainly involved in the house market, believed that SUDS have no effect whatsoever either on house price or saleability, a response that was not outlined by participants of any other profession. Participants of all other professions believed that SUDS within a residential area have a positive effect on house pricing and saleability, or, alternatively that the effect could either be positive or negative depending on design and appearance. The profession-based results are presented in Figure 5-7.

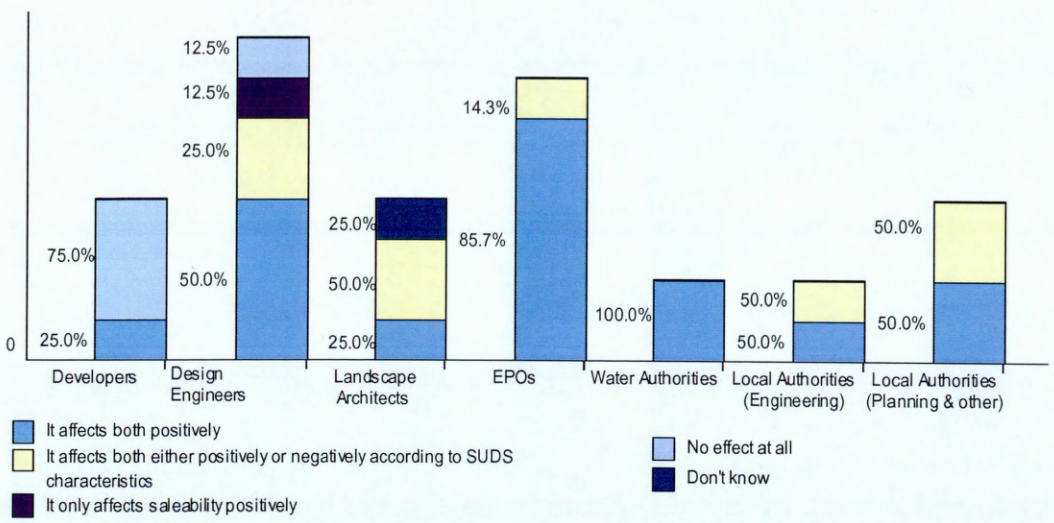


Figure 5-7 Profession-based perception on house pricing & saleability

Finally, land take seems to be the principal perceived barrier to SUDS for developers and it was perceived by all professionals as a major constraint on developers. Design engineers and

EPOs seemed to consider adoption and maintenance, and the lack of knowledge and experience amongst the 'so-called' SUDS specialists as the main barriers to wide use of SUDS. Professionals from local authorities believed that the main barrier is to convince water authorities to adopt SUDS, whilst landscape architects referred to adoption and maintenance. They also said that landscaping around SUDS should be taken into consideration when the systems are designed and not after construction as this often results poor examples.

5.2.4 Focus Groups Results

The results of the 3 focus groups, with Aberdeenshire City Council, academics and researchers involved with SUDS and SEPA EPOs gave a more in-depth and holistic view of professional attitudes to SUDS. Due to the similarities in perceptions the results of all focus groups are presented together. Minor differences in opinions were based on the professional interests of the participants. The analysis of this information is qualitative and thematic.

Amenity

Most participants in all focus groups believed that the amenity value of SUDS varies according to the type of SUDS used in a particular area. Infiltration trenches for example, are of no amenity value, swales and detention basins have the potential to be of some amenity value. On the other hand amenity is an important element of SUDS ponds and wetlands.

> *"The amenity value of ponds is high when the landscaping of the pond is carefully designed to make the pond look as natural as possible. Easy and safe access to the pond is crucial for ensuring enhancement of the pond's amenity value"* (view of a local authority officer).

It was suggested that detention basins could be used as football pitches during dry periods and in this way their amenity value and their public acceptability would increase. The public tends to appreciate only properly designed SUDS - those which look natural and have dual purposes, i.e can be used for recreational activities, with walkways around them and are in parkland type developments. On the contrary, poorly designed SUDS ponds become untidy through lack of maintenance and are often characterised by the public as an eyesore and unacceptable. An interesting attitude was that if ponds are remote from the development and not in front of houses, people tend to appreciate them more and make more use of them as their concerns over

safety reduce. In this case people appreciate the fact that SUDS ponds often look natural but at the same time the vegetation and wildlife are managed. Where the systems are well designed and landscaped and wildlife is present, the public highly values the amenity and they regularly use them as they would use parks. The size and the location of the pond plays an important role in public perception and appreciation of amenity; if ponds or wetlands are located within a big open space and they are large enough to resemble natural lochs people tended to value them more highly.

Participants believed that SUDS have public, habitat and technical amenity value. They defined the public amenity value as the value that the public obtain from using SUDS as amenity features. Using SUDS ponds and wetlands for recreation and leisure was the main amenity benefit of the systems. Local residents use ponds and wetlands for recreation, as pet walking areas, as areas for relaxation and as educational sites for children. To illustrate this, an example of locating a SUDS pond in the open space around a new church was mentioned. The idea is that the church-ground will be used for Sunday school trips. A second example underlining the public amenity value was brought up regarding the construction of a multi-stage wetland with dry land storage, where the local residents made specific requests for walkways to be constructed around the pond and for information boards to be erected.

In matters of habitat amenity value, the benefit to biodiversity and the creation of new habitats in SUDS ponds or wetlands were mentioned. The attraction of new areas for species, such as dragonflies and frogs, was considered as one of the main benefits of SUDS. The term technical amenity value was regarded by participants to mean the amenity provided by the proper functioning of the systems. The storage capacity as well as the treatment function of the SUDS ponds and wetlands was considered as a technical amenity benefit of SUDS. Additionally the flood prevention aspect of SUDS was underlined. However, there is little public awareness and understanding of the flood prevention function of SUDS. "*People tend to panic when they see grassed areas filling up with water, they wouldn't understand the concept behind this function and their attitude towards SUDS would often be negative*" (male - EPO). In general, members of the public do not appreciate the amenity aspect of SUDS and they would have to be further educated on the matter and reminded of the function served by their local pond to appreciate the systems more.

Biodiversity

Although the participants recognised the biodiversity benefit of SUDS ponds and wetlands, they underlined the fact that biodiversity tends to decrease with time. As the area builds up, more pollutants end up in the ponds and wetlands. Additionally, if the pond is kept as natural as possible then several plants develop, many of them unwanted and are considered by most people to be weeds.

A female academic participating in the survey, stated:

> *"Although the ponds improve aesthetically with time, as they tend to look more natural, their biodiversity value reduces. The amount of pollutants, especially heavy metals, increases in the ponds as the residential areas develop fast, which is not beneficial to biodiversity. Pollution eventually kills several species, especially the macro-invertebrates and the animals present in the pond".* (female - researcher).

Ponds and wetlands cannot sustain these types of species for very long periods, as the availability of food decreases with time and levels of pollution present within ecosystems.

> *"From the public's point of view, species that are small enough such as insects, spiders, and wild small plants are not considered as biodiversity. It's only bigger species such as ducks, swans, and rabbit that are perceived as biodiversity"* (view of a male academic).

Even crows or other birds common to the area are not highly appreciated, as people believe these species would have been there anyway. The general public does not have the correct perception towards what is beneficial to biodiversity. Fish in a pond or a wetland are perceived by the public as a biodiversity indicator. When fish are present in small ponds they tend to use up with much of their food sources, and the species decrease dramatically. On the other hand, people enjoy feeding fish within a pond so the fish population could be sustained without harming other species and the amenity value of the pond would increase.

Safety Concerns

All participants believed that the safety concern of SUDS ponds and wetlands perceived and not actual. They believed that SUDS are safe enough to be located within residential areas provided that safety precautions are taken into consideration before the systems are designed

and implemented. A risk assessment is necessary before a pond is constructed. The main safety concerns expressed by the participants referred to the cases of small children been trapped accidentally in the pond or the general danger of an individual falling through thin ice in winter and being trapped and drowned in the pond. The participants felt that barrier planting, in combination with appropriate side slopes could prevent small children from entering the pond.

> *"To the eyes of the public there is a level of risk involved with SUDS, which possibly derives from the fact that SUDS are man-made and not natural constructions, and additionally they are new types of systems whose function and purpose are not well understood yet"* (view of a male in local authority).

It was agreed by the participants that the perceived safety concern is a matter to be addressed by public education. They believed that if the public knew the function of the pond and they were aware of the fact that the majority of SUDS ponds are designed with safety in mind they would not worry. Additionally, people should learn how to behave close to watercourses. The behaviour around SUDS ponds and wetlands should be the same as with natural watercourses, and children should not be left unattended close to open water whether it is constructed or natural. People who have never lived close to the sea or to any water body most often express high safety concerns. Although Scotland is surrounded by sea and there are numerous lochs, people express concerns over the ponds. There are several reasons for that. People find it quite unlikely that children will run to the next loch or to the beach because houses are usually situated relatively far from natural watercourses, while it is easier for children to run to the SUDS pond placed on their doorstep. There is also a constructed fear towards artificial watercourses.

> *"Natural watercourses are accepted by default as they are in place by nature and therefore, in people's minds, there must be good reasons for their existence. On the other hand constructed watercourses are not in place by nature and they are perceived as an additional hazard that could have been avoided"* (male - academic).

Participants believed that if people were reassured on matters of safety and about the ease in accessibility towards and from the ponds, they would accept SUDS much more easily. *"In reality, according to statistics it is safer for a child to be close to a pond rather than to cross*

the road to reach the pond" (view of a female - EPO). Although people want zero risk imposed by the pond they will happily risk crossing the road or driving to get there.

An interesting safety concern expressed during one of the focus groups was the danger of bird strikes caused by birds gathering in SUD ponds close to airports. However, the participants mentioned that there is no real risk of bird strikes if the SUDS pond is located a safe distance from flight paths. The participants believed that the drowning risk is minimal as ponds are designed to be safe. Most participants considered that canals and rivers are more dangerous than ponds yet residents do not complain about them. Fencing was not considered to be appropriate since natural watercourses, ponds and rivers, are not normally fenced. Consequently in order to protect the amenity value of SUDS ponds should not be fenced.

Professional Suggestions on Design Characteristics

The suggested changes to the design of SUDS related to the safety issues mentioned above. Rich marginal vegetation, adoption of soft engineering practices, and the construction of ponds according to the CIRIA manual, were suggested.

Landscaping of the ponds with amenity in mind was also suggested by many participants.

> *"Proper landscaping, which should be applied along with the pond design. It is a mistake to first put the pond in place and then try to create nice surroundings, landscaping has to develop at the same time as design and pond built up". "More specialists, designers that are qualified and trained in designing and applying SUDS, more knowledgeable designers, this is what is needed"* (male - academic).

Fencing was thought to be inappropriate as it would decrease the aesthetic and amenity value and children would be challenged to climb over fences. Suggestions were made that ponds and wetlands should be designed with shallow gradients to dissuade a walker from reaching deep water. Participants again felt that there is huge lack of education, creating a major barrier for public acceptability. It was also suggested that introducing notice boards around ponds warning of the danger of deep water or thin ice, as well as the design of ponds and wetlands with amenity in mind would increase public acceptability. *"More space allocated to SUDS. Developers are trying to put SUDS at the corner – at the back of the development"* (male - local authority).

Effect on house price and saleability

In areas with attractive SUD schemes, there is a possible effect on house pricing and saleability. However, the price of houses in these areas would not increase dramatically and this is a major drawback for developers. *"Developers could turn SUDS into amenity features and use them as marketing tools to advertise and sell houses more easily"* (female - EPO). On the other hand, constructing SUDS within a development with the associated land take would result in housing plots being available. Although there might be an increase in house prices, this still will not be enough to cover the loss caused by the loss of housing plots occupied by the SUDS.

Additionally, although the majority of buyers would definitely prefer to buy a house with a nice view and overviewing an open space area, it is not clear if people would be willing to pay more for a house as indicated by the public perception surveys.

> *"Although the houses built in front of ponds wouldn't be priced higher than the same type of houses placed at the back of the site, the developers would place the bigger and, therefore more difficult to sell houses, to overlook the pond or the wetland area. They wouldn't build a tiny house in front of a big pond"* (female - SEPA).

There were different perceptions about the possible effect of SUD schemes within a residential area on house pricing and saleability. Some of the participants believed that a green open space, a pond or a wetland in front of houses could increase house prices. They believed that most people would be willing to pay more for a house overlooking an open space of any kind, including a pond, provided that the design and the landscape are satisfactory. *"People prefer houses in front of ponds due to the nice setting and due to the fact that no new houses are likely to be built in front of the already existing houses obstructing the view"* (female - local authority). To support this attitude, the Environment Protection Officers gave examples of cases such as the Linburn pond and other areas with SUD ponds in England and Wales where local residents were more willing to buy houses overlooking a pond. However, they could not identify the actual effect on house pricing which, they believed, principally occurs when houses are resold.

The participants agreed that it is only ponds and wetlands, and not other types of SUDS which could have a positive effect on house pricing. This is also limited to houses of middle or upper

class individuals or families without young children. Other types of SUDS are either not recognised by the members of the public and have no effect on house pricing or they may even have a negative effect. A large number of people believe that SUD schemes are responsible for concentrating excess amounts of water in back gardens. Whether this rumour is true or not, it still creates negativity towards SUDS systems and could affect prices negatively. Furthermore, there are other implications for the saleability and pricing of houses located close to SUDS. As one male - researcher stated: *"Another problem with SUDS acceptability is the fact that insurance companies refuse to insure houses if they are not located more than 50 m away from any watercourse due to high flood risk"*. Many houses directly overlook SUD ponds with distances shorter than 50 m, possibly having have a very obvious negative effect on saleability and even on house pricing.

However, the participants agreed that houses of the same characteristics are initially sold at the same prices regardless of their place within the development. It is when the houses are resold that there could be an influence in saleability or house pricing, either positive or negative.

SUDS and flood prevention

The academics participating in the survey underlined the flood prevention capability of SUD schemes. They all agreed that if the systems are designed, installed and maintained properly, they then can provide high level of flood prevention. It seems that maintenance is the key issue for the proper function of SUDS and therefore for public acceptability of the systems. If SUDS are not properly maintained then they tend to flood after even small rain events.

> *"...even badly designed SUDS are estimated to provide better flood prevention than the traditional piping systems. The reason is that SUDS are designed for 30 years return period while traditional pipes are designed for a 10-year return period and they are expected to flood every 2nd year due to the expected 30% estimated increase in rainfall within the next 50 years due to climate change"* (male - academic).

Although the effect of the climate change on rainfall patterns is taken into consideration in the design of SUDS, there is no similar consideration for traditional pipes for runoff collection, pointing to the greater reliability of SUDS for flood prevention. However, the public often accuse SUD ponds, wetlands, and detention basins of causing floods as the systems gather the

excess amounts of water above ground and not hide it in underground systems. This attitude demonstrates an example of public perception based on wrong information and assumptions.

Barriers to SUDS' use

Land take was identified as the main deterrent for developers accepting and incorporating SUDS within new developments. A major problem in housing developments is where no space has been allocated to SUDS. One EPO stated: *"The SUDS requirement should have become a planning constrain, relevant to the planning requirement for play areas and open urban spaces within housing developments. A good idea could have been to include SUDS within the open urban spaces"*. In this way developers may be more willing to incorporate SUDS in new developments as they would not lose additional space. If planners made SUDS a prerequisite for new developments then developers would have no choice but to comply. Another constraint on the incorporation of SUDS in new housing areas, mainly for SUDS ponds and wetlands, is the overall cost. *"Although the cost for SUDS construction is low, the cost of landscaping is usually high, as for example in the case of Linburn pond"* (male - SEPA). On the other hand, if SUDS are included in the original plans and landscaping uses species native to the area, the cost is reduced and SUDS more easily accepted by developers.

The participants considered the attitude of water authorities, and in particular that of Scottish Water, as another major barrier to SUDS application.

> *"Although Scottish Water appears to be pro-SUDS and pro-sustainability at the same time they do not engage sustainable practices such as educating the public in relevant issues and encouraging the public to collect rain water in water buckets so as to eliminate the amounts of runoff entering SUD schemes and save water and energy"* (female - researcher).

At the same time, Scottish Water has not yet fully agreed to adopt and maintain SUDS. Maintenance is a barrier to SUDS, not only due to the cost but also due to the allocation of responsibility. The developers are not happy to undertake this responsibility and at the same time Scottish Water, the local authorities and SEPA are refusing to adopt maintenance. If Scottish Water adopted and maintained SUDS then developers could probably be more willing to include SUDS within their new developments.

The right choice of SUD systems for the soil conditions in the locality are considered to be very important and, for example, many sites are not suitable for infiltration trenches. However,

"they are often put in place just because SEPA enforces SUDS" (male - researcher). Developers prefer infiltration trenches especially since they do not take up a lot of land.

Public education and engagement in planning was once again mentioned. It seems that the lack of information to the public and stakeholders, in this case mainly developers, and insufficient public consultation in the planning procedure are main deterrents to SUDS within residential areas. A public educated on the purpose and benefits of SUDS would welcome them within their residential area and developers would not object to constructing them. Participants in this research phase believed that if the public were to be actively involved in the planning and decision making process, they would not feel neglected and would be keener to accept these systems. In addition, they could provide the decision makers with new ideas on how to incorporate the ponds in the best possible way within established residential areas. This might also convince the local community to welcome and make good use of the new scheme for recreation and also to contribute to their everyday maintenance.

> *"On the other hand, if SUDS were enforced via certain regulations, and developers had to comply with these regulations, then although it would have still been difficult to retrofit SUDS in old developments they could at least be incorporated within new developments"* (view of a local authority officer).

The same participant supported this attitude by stating that when SUDS are a prerequisite for housing development, they have to be implemented regardless of the objections of developers. Developers are usually concerned over issues such as public acceptability of the schemes, maintenance of the systems, cost, and land take. From the developers point of view land take is a major issue since a new pond requires an area the same as approximately four houses and this cannot be covered by any possible increase in house prices. According to developers, their profit from a new housing development comes from one in four houses. To compensate for the loss of four houses for a pond, developers would have to sell sixteen houses. However, as one EPO observed, if SUDS were enforced and developers knew from the very beginning of purchasing the land that SUDS are a planning requirements along with open green space, playgrounds, and football pitches, they would have no other option than implementing them.

5.3 DISCUSSION

Overall, the attitudes of professionals involved with SUDS were in agreement with the attitudes of members of the public. However, professionals referred to technical issues and details of which the public was unaware. On this basis they believed that using SUDS is an efficient way of attenuating flow and treating runoff. They recognise the flood prevention capabilities of SUDS and most share the opinion that SUDS should become a planning prerequisite for new developments.

The majority of participants highly valued the amenity and biodiversity benefits of SUDS, especially ponds and wetlands. Other types of SUDS such as swales, filter drains, and infiltration trenches were perceived to be of low amenity or biodiversity value. Professionals linked amenity mainly to wildlife benefits, improvement of the aesthetics of the surrounding area, recreation and leisure. However, the amenity and biodiversity benefits are thought not to be widely realised by the public, especially in newly established schemes. However, according to the professionals, the public tends to appreciate and make use of SUD ponds and wetlands for recreation when the systems resemble natural ponds and there is evidence of wildlife.

Almost half of the participants believed that SUDS are safe close to houses provided that they are designed with safety in mind. A high percentage of the participants (36%) considered SUDS to be safe and much safer than a road of heavy traffic. They believed that other dangers present in urban environments are higher than the danger of accidental drowning of children in SUDS ponds. This attitude agrees with the ROSPA statistics on causes of drowning accidents presented in Chapter 4. Other SUDS safety concerns were also raised such as the danger from bird strikes, when SUDS are located within airport areas.

Many participants considered that there is a perceived and not an actual safety concern regarding SUDS ponds and wetlands. This perception is more common amongst people who have never lived close to watercourses. At the same time, a degree of fear of watercourses has been created in general, generated from negative experiences in areas with poorly conceived and designed SUDS. This argument is in complete agreement with the results of the public perception survey which evaluated the safety risk of open watercourses.

The use of soft engineering such as shallow slopes, avoiding deep water, rich marginal vegetation, as well as educating the public were suggested to increase the safety of SUDS ponds and enhance public acceptability. Other improvements suggested, not related to safety,

were the natural appearance of landscaping around the ponds, the improved maintenance, and more adequate training of SUDS specialists and designers. Design engineers and EPOs were made most suggestions on improvements regarding design amendments to enhance public acceptability, while developers thought that public information is the key issue.

Overall, although the participants believed that SUD ponds and wetlands, but not other types of SUDS, could have a positive effect on house pricing and saleability, they were unable to provide any hard data to support their opinion. In contrast, 75% of developers stated that there is no effect whatsoever. Most of the participants believed that many people would be willing to pay more for a house overlooking an open green space or a natural-looking pond. However, concerns were expressed over the negative effect on house prices by insurance policies refusing to insure houses located near open water.

The main barriers to the use of SUDS outlined by the participants were land take, which is the developers' main concern, adoption and maintenance and the reluctance of developers, planners and the water authority to install SUDS. Other barriers such as cost, safety, and lack of expertise amongst SUDS specialists were also mentioned. The issue of public acceptability, which the participants directly linked with information and consultation in planning, is also a major issue of concern for the adoption of SUDS. The participants believed that the lack of public consultation can be a deterrent to implementing SUDS while, in contrast, public engagement can be a strong motive towards adopting schemes.

5.4 NEXT STEPS IN THE RESEARCH

The public and professional perception surveys on SUDS identified advantages and disadvantages of SUDS schemes and helped to make recommendations that can enhance their acceptability. However, SUDS are types of stormwater management systems which are most commonly met in U.S.A. and in some countries in Europe.

The different stormwater management practices adopted in different countries or in different regions of the same country are based on a series of characteristics such as the hydrological, geological and socio-economic conditions of the area. River management one of the oldest and most widely used stormwater management practices. Traditional river management involved culverting of streams and rivers in urban areas, while recently there has been a trend towards more environmentally friendly and sustainable options. As a stormwater management practice,

river restoration in combination with landscaping of the surrounding area has become increasingly popular and is often supported by flow attenuation structures such as SUDS.

The assessment of perceptions of these new approaches in stormwater management also formed part of this research programme. The main incentive for this decision was to obtain an overview of perceptions of popular stormwater management practices in two European countries.

Three sites were studies, each situated in flood-prone areas of heavily urbanised cities, Glasgow, London, and Athens. This research phase assessed the flooding issues, assessed the overall public and professional perceptions of the different control methods used in the two countries and recommended how to improve the rivers. The results presented in detail in Chapter 6.

6 COMPARATIVE STUDY OF RIVER MANAGEMENT PRACTICES IN THREE EUROPEAN CITIES

"A river is more than an amenity, it is a treasure."
— Quoted by the Supreme Court in its decision in U.S. v. Republic Steel, 1960

6.1 INTRODUCTION - STUDY DETAILS

This chapter presents results from the comparative study on different stormwater management techniques in three major cities within two European countries. The increasing trend towards using SUDS or combining SUDS with other stormwater management practices such as river management was a major incentive for undertaking this comparative study. Although river management has traditionally been a component of stormwater management, river restoration and landscaping of its surroundings and the use of SUDS are more recent approaches. As in the case of SUDS, the perceptions of professionals and members of the public are vital for these new approaches.

The comparative study on perceptions of stormwater management practices between Glasgow and London in the UK and Athens in Greece, was undertaken during the research period 2003-2004. The sites selected were located within flood-prone suburban areas, and the stormwater management strategies in all three cases involved river management. In Glasgow, the improvement strategy proposed looks at a combined approach, incorporating river restoration and retrofit of SUDS. In London, the strategy involved only river restoration, while in Greece, the solution adopted was to culvert the river. The three approaches to stormwater management provided the basis for comparison between the sites. Detailed information on each site is presented later in the text.

The comparative study had the potential to deliver a holistic understanding of public attitudes at an international level. The study could also provide the basis for recommendations on how to engage the public in river planning for increased amenity value successfully, and how to enhance public acceptability of new water related schemes within established residential areas.

An additional outcome of the study is the evaluation of perceptions of the flow attenuation and flood prevention elements of the schemes.

This research phase made use of a combination of quantitative and qualitative investigative methods for the assessment of public and professional perceptions, making use of the experience on perceptions of SUDS gained during the previous research phases.

6.1.1 Study Objectives

The main objective of this part of the research was to evaluate and compare different stormwater management techniques, from a social perspective, in three major European cities. To satisfy this objective the following sub objectives were set:

- To assess public perception of environmental issues and flood related issues;
- To evaluate the stormwater management strategies proposed;
- To evaluate possible safety risks and different environmentally friendly practices related to the stormwater management strategies either proposed or already completed;
- To compare perceptions of stormwater management practices in the three areas of interest.

6.1.2 Survey Methodology

A door-to-door survey was carried out in the Shettleston and Tollcross areas of Glasgow in October 2003. The London survey in the Brent River area was in November 2003 and the Athens survey was between February and April 2004. All surveys drew on previous experience gained through the public and professional perception surveys on SUDS. Consequently, a combination of investigative methods was used during this research phase.

The surveys in Glasgow and London followed the same format and objective as the public perception surveys on SUDS, using door-to-door interviewer-administered questionnaires with open-ended questions. The door-to-door surveys were fairly straightforward, the response rates were similar to the SUDS surveys and approximately 100 questionnaires were completed in

each area. About one third of householders at each location took part in the survey. Roughly half of the householders were absent, and some of those who answered their doors did not wish to participate. Second attempts to question householders who were unavailable during the first visit were made at all of the sites. In total, in each area, around 60% of the householders who were approached participated in the surveys. This response rate was considered satisfactory.

In London there was an additional attempt to gather attitudes of householders via a postal survey. However, the postal survey response rate was very low with only 21 out of about 1000 questionnaires sent being returned to Brent Council. Such a low response rate can be accounted for by the fact that residents in the area had been repeatedly asked to complete postal questionnaires related to the river restoration scheme during the preceding 5 years. Due to the very low response rate, the results from the postal survey were not considered with the door-to-door survey results.

A door-to-door survey for Athens was inappropriate at the time. The culverting of the main river in the city of Athens had generated much negativity amongst residents in the surrounding area from a very early stage of the construction process. This negativity was openly expressed through the press and through a series of public initiatives. Members of the Hellenic Ministry of Environment, Physical Planning and Public Works and the researcher shared the feeling that a door-to-door survey in the area could potentially give rise to further opposition, which would most certainly bias results, and it was decided not to use this survey method.

However, 25 semi-structured interviews were held with selected individuals, either members of the public or professionals who were involved in the works at the Kifisos River in Athens. The interviews were to assess perceptions regarding the river culverting scheme. Care was taken during the selection of members of the public to be interviewed and it was decided that they should have had an involvement in or had been affected by the scheme and had already openly expressed attitudes. As a result, representatives of a community involvement group called Kifi-SOS, were approached. This community group had around 300 members and has openly opposed the works at the river. The professionals interviewed were academics, researchers, and consultants. The semi-structured interviews took place in Athens during the period January – April 2004.

The site characteristics research are summarised in Table 6-1.

Table 6-1 Site characteristics

Sites	Socio-economic class	Sample Size	Option	Function	Aesthetics	Investigative method used
Glasgow Sites	Lower to Medium	100	Proposed river restoration and retrofitting of SUDS	Flow attenuation, water treatment, environmental conservation	Low at the present moment	Door-to-door questionnaire
London Sites	Lower to Medium	100	River restoration	Flow attenuation, water treatment, environmental conservation	High	Door-to-door & postal questionnaire
Athens	Lower to Medium	25	River culverting	Flow attenuation	Low	Personal interviews

6.2 GLASGOW PROJECT

6.2.1 Site Background Information

The Shettleston and Tollcross areas have a population of 25,000 and are located in the east end of Glasgow. The area has a network of of streams as shown in Figure 6-1.

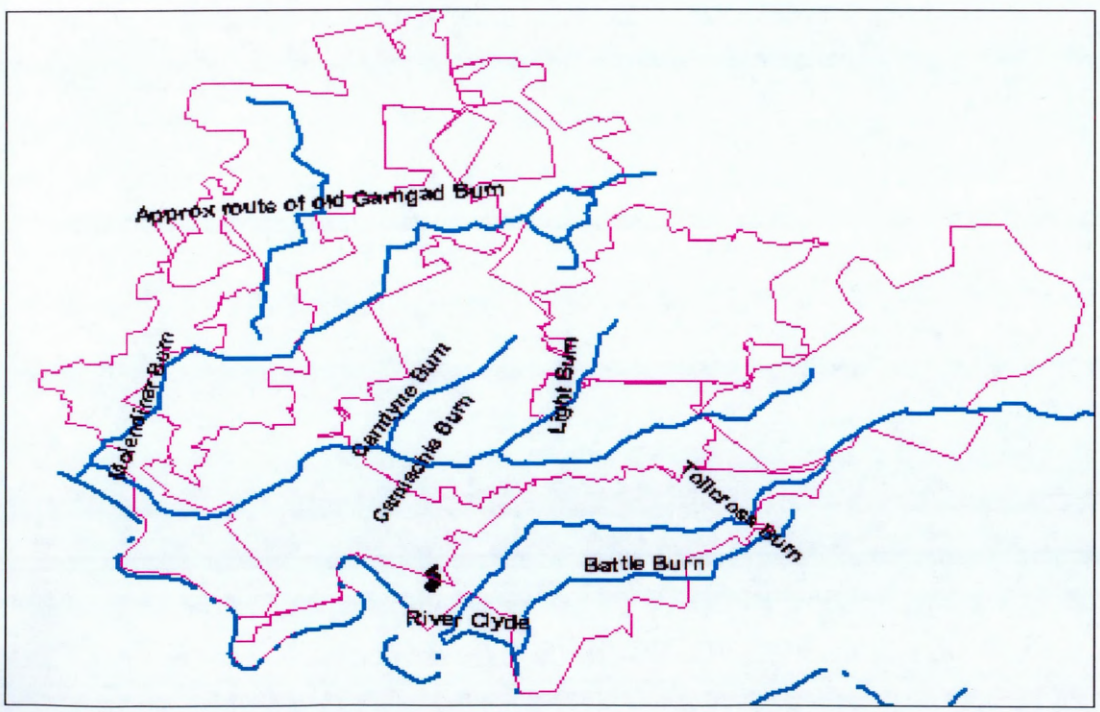


Figure 6-1 Watercourses in the east end of Glasgow. (Singh R., 2003)

Land use in the area comprises industrial estates, derelict industrial areas, residential and commercial areas. There are also a number of green-field areas, which have been earmarked for future developments (Singh R., 2003).

Both are high-density suburban areas of medium to low socio-economic background served by combined sewer systems. The Shettleston & Tollcross sewer runs parallel to the Tollcross Burn. The Tollcross Burn has a catchment area of 6.1ha and runs through both study areas, Sandyhills Park and the Tollcross area close to Tollcross Park. During heavy rainfall events, large volumes of surface water enter the combined sewers resulting in flooding and pollution to the surrounding area. The catchments suffer both from flooding and combined sewer overflow spills and the streets mainly affected are Sandyhills Road, Loch Achray Street, Strowan Crescent, Ardgay Street, Glenalmond Street, Rattray Street and Shettleston Road.

River restoration including enlargement of the riverbanks, retrofitting of SUDS and landscaping of the surrounding area is under preliminary consideration in both areas. This is linked to a wide-ranging study of drainage options in the east side of Glasgow commissioned by Glasgow City Council and Scottish Water.

The stormwater management strategy suggested for Shettleston is to disconnect the surface water runoff from the combined sewers of Sandyhills Park, use SUDS to attenuate the flow and connect the SUD schemes to the stream. The recommendation for Sandyhills Area 1, is to collect runoff from the residential area via pipes and lead the water into a detention basin built at the edge of Sandyhills Park. Swales will then convey the water into an online pond, which will be connected to the stream and ultimately the River Clyde. The suggestion for Sandyhills Area 2 focuses on collecting runoff from two Tower Blocks (4 buildings) and their car parks, located at the edge of Sandyhills Park, with underground pipes. Roadside Swales will be used to attenuate the flow. The swales would then be connected to the aforementioned online pond linked to the stream. The strategy suggested for the Sandyhills Area 2 is presented in Figure 6-2.

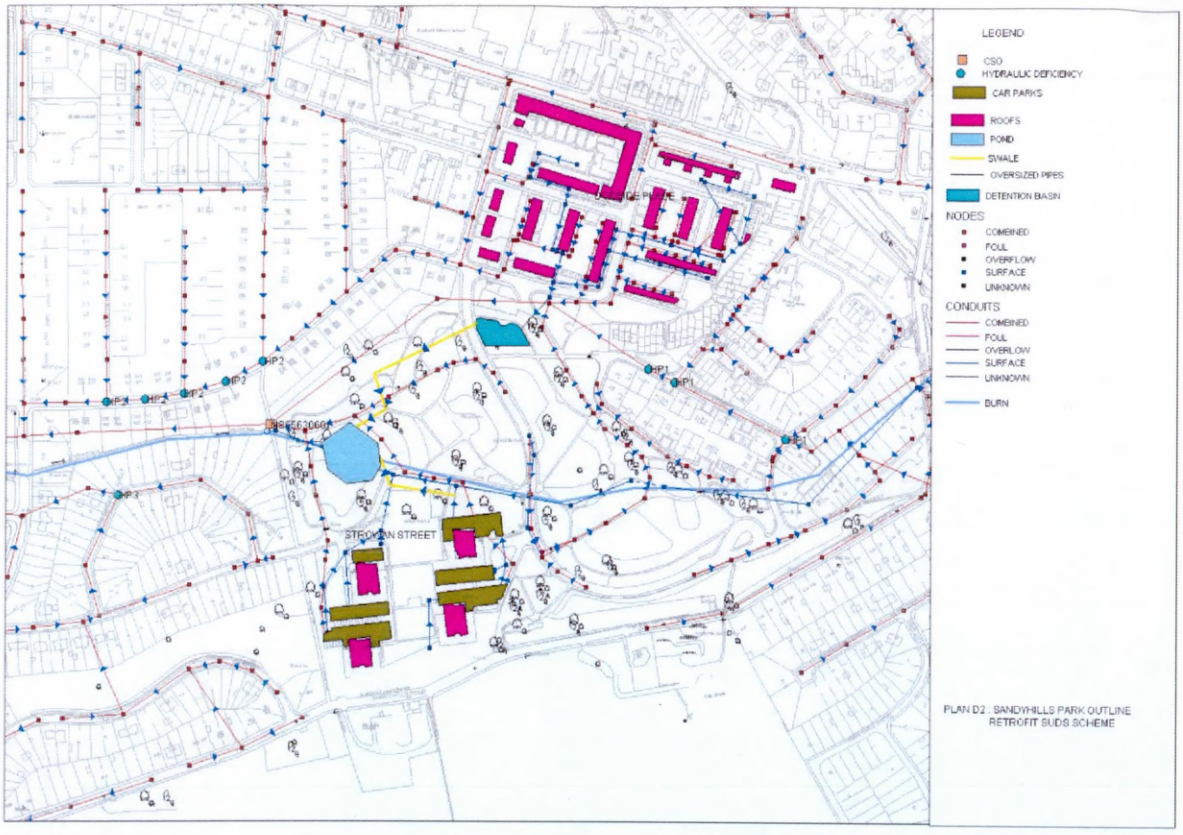


Figure 6-2 Strategy Suggested for Sandyhills Area (Singh R., 2003)

In the Tollcross area, the strategy involves disconnection of stormwater from the combined sewer. SUDS would be retro-fitted in two streets in the area. The plan for Tollcross Area 1 is to pipe the water from the roof of a McVities factory (0.035km^2 of roof) to a roadside swale. At the same time runoff will also be collected from a tarmac car park via swales. Swales will convey the water to a detention basin situated close to the Tollcross Burn. For Tollcross Area 2, it is proposed to collect the runoff from a residential road via another roadside swale and convey it to the same detention basin. The outlet of the detention basin will be piped to the stream culvert. The suggested strategy for the Tollcross Area is presented in Figure 6-3.

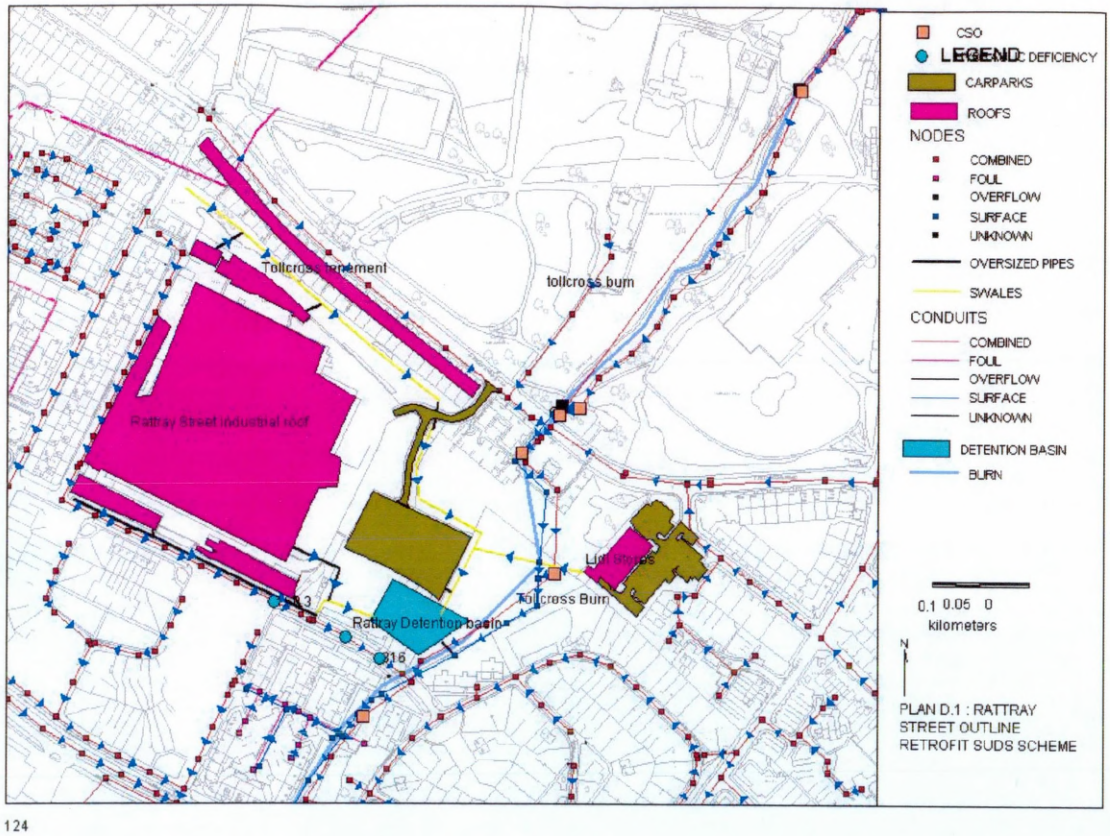


Figure 6-3 Strategy Suggested for Tollcross Area (Singh R., 2003)

6.2.2 Review of the Flooding Issue

Many of the streams in Glasgow have disappeared into sewers and culverts under the pressure of urbanisation. The culverted burns between the Tollcross Burn and the River Kelvin are: the Camlachie Burn, the Molendinar Burn, the St. Enoch's Burn, the Finnieston Burn and the Pinkston Burn (The Herald, 1923).

The culverting of burns and increasing rate of urbanisation have contributed to increased stress on the Victorian combined sewers. In turn this has resulted in several flooding incidents in the greater Glasgow area. Although flooding in Glasgow has increased lately it is not a new phenomenon, as illustrated in Figure 6-4.

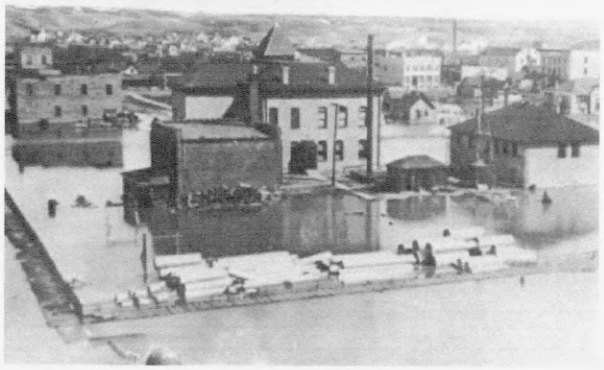


Figure 6-4 Floods in Glasgow, 1912

An increase in rainfall in Scotland over the next 100 years due to climate change has been predicted. It is estimated that by 2080 the increase in rainfall over some parts of Scotland could be between 10-25%.

> *"Grey skies have clouded the city since the beginning of June with more rainfall than at any time since 1885 ... weather centres recorded 131 mm (5.16 in) of rain during June – more than double the average- and just 99 hours of sunshine making it the dullest since 1966"* (Herald on the 11th of July 2002).

A very significant flood incident in Glasgow, the largest storm event for many years occurred in July 2002 when a summer thunderstorm hit the city.

> *"Glasgow had 30 mm of rain in one day – almost half the average 74mm of rain for the whole July, according to the Met Office"* (The Herald, 2002b).

The storm of the 30th of July 2002 lasted a total of 10 hours. The rainfall depth was 75mm with a maximum intensity of 94.5mm/hr, which equates to a return period of 100 years. According to a SEPA and Scottish Water report, the flooding occurred because the drains, sewers, and culverts are simply not designed to convey a 100-year storm event (SEPA & Scottish Water Report, 2002). The result of this storm was that 193 houses were severely damaged – 134 council houses and 53 private properties. The estimated damage to council houses was about £2 million.

The most severe flooding occurred in Shettleston (Nicoll, 2002). Dozens of houses had to be evacuated by firemen and people were moved away from their properties in inflatable boats; 34 families had to be moved to temporary accommodation, and an extra 950 roofs and drains had to be repaired. (Tinning W., Briggs B., McGuire A., 2002), (Gordon T., 2002). It was estimated that more than 1000 people were affected in total. (Anderson B, Leask D., 2002).

Figure 6-5 Fire officers rescue residents from their flooded houses

One of the main areas affected was in Sandyhills, specifically Argay and Strowan Crescent. A door-to-door questionnaires and a focus group, as part of this project, were undertaken in this area, the results of which are presented later in the text. The residents of these areas have repeatedly reported that they are at risk from flooding during every heavy rainfall event and they provided the researcher with photographs of their properties before and after flooding. Two are included as Figure 6-6 & Figure 6-7.

Figure 6-6 Back garden before flooding

Figure 6-7 Back garden after flooding

A survey by SEPA showed that 6% of Glasgow residents surveyed stated that they had been flooded at least once. Additionally, the same survey showed that more than 26,000 homes in and around Glasgow are at risk from river flooding. (Evening Times online, 2002).

> *"93,000 homes and properties are at risk from coastal floods and an additional 77,000 are under threat from inland flooding. The current annual cost of damage from inland flooding is estimated at 20 million pounds – but in the worst-case scenario climate change will more than double that cost to 43 m pounds by 2080"* (Naysmith S., 2002).

6.2.3 Overview of Results

Overall, the majority of participants who took part in the surveys agreed with the proposed plans in both areas of Glasgow. As expected, the major public concern was over safety. However, this was not perceived to be such a great threat that it put residents off from approving the proposals.

The results are presented as combined results from both sites since no significant differences were identified between the attitudes expressed at either site. The results are presented per question or per group of questions, starting with questions about general environmental issues and continuing with more specific questions about stormwater management preferences for each area. Gender-based and age-based analyses are also presented when there are differences related to the gender or the age of the participants.

6.2.4 Results per Group of Questions

Environmental Awareness, Concerns and Water Quality

Low levels awareness regarding general environmental issues were identified in both areas examined in Glasgow. The most common responses are presented in detail in Figure 6-8.

Just under 25% of participants stated that they had no environmental concerns. The most common environmental concerns expressed included: air pollution the disposal and treatment of solid waste, litter in their direct environment, and water pollution, while other issues were also mentioned. *"The only environmental concern I have for this area is the mobile phone masts, nothing else."*

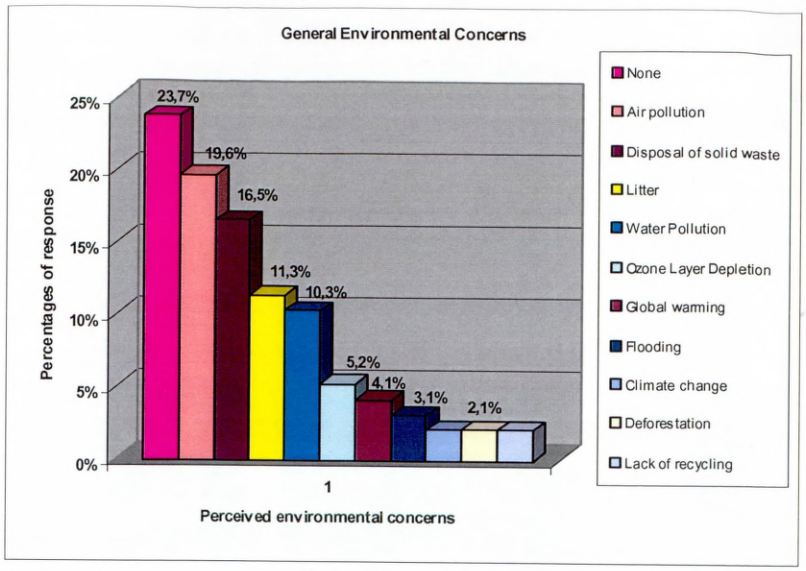


Figure 6-8 General environmental concerns

Everyday activities that contribute to water pollution via drains; the disposal of solid waste down road grids was identified as the main contribution. Equally, 22% of participants believed that none of their everyday activities contributed to water pollution. The results are presented in Figure 6-9.

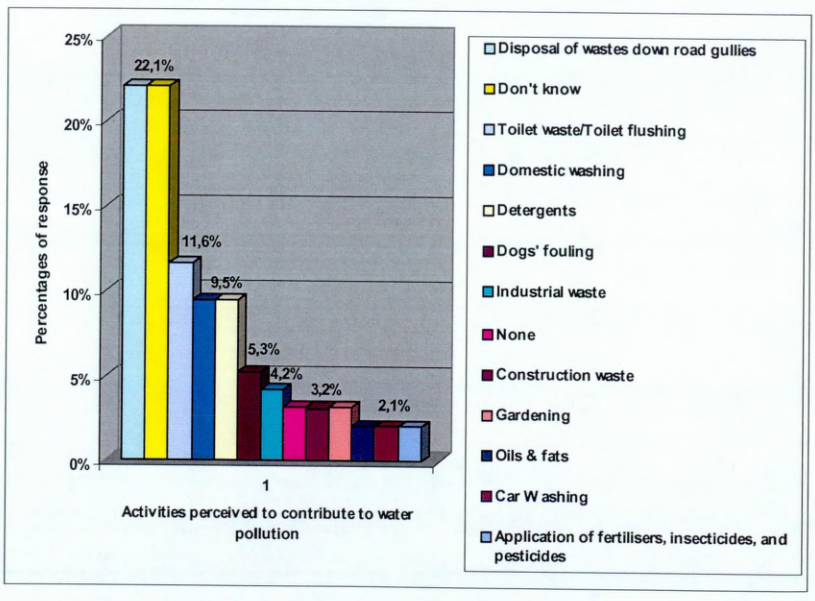


Figure 6-9 Personal contribution to water pollution

Very low levels of awareness of the stream were identified in the Shettleston area, where parts of the Tollcross Burn are open and obvious to the public,. The majority of participants in the

area could not indicate the location or route of the stream, while only 32% of the respondents were aware of the fact that it is connected to the River Clyde.

The participants in this area were asked to rate the water quality of the stream and make suggestions on how to improve it. The rating results are described in Table 6-2.

Table 6-2 Rating of stream water quality

Rating	Percentage of Participants
1: Very satisfactory	0
2: Satisfactory	11
3: Not excellent but still not dirty	41
4: Polluted	22
5: Highly polluted	26

Two suggestions were made in relation to how water quality in the river could be improved. These were to educate people to stop throwing litter into the river and to regularly tidy up the river.

Sandyhills park area in Shettleston is a flood prone area and local residents indicated that flooding incidents occur once or twice a year over the last 10 years. Several properties located close to the burn at Strowan Crescent and at Loch Achray St. flood very frequently. The houses were built 13 years ago on a flood plain and are affected more than others. The participants felt that the Water and the local Authorities have not dealt with the issue appropriately, stating that only emergency measures such as the distribution of sandbags and moving residents to temporary housing are taken during flood events, while nothing permanent has been done. *"The authorities evacuate houses every time flooding occurs, they move the residents away, then drain the houses, and people return until next time!"*. Extensive reference to the flooding problems of the area was made during the focus group with residents of Strowan Crescent, the results of which are presented in section 6.2.5. In Tollcross, there is no serious flooding issue and flooding incidents occur rarely and only in the natural flood plain area. The proposed plan includes the construction of a detention basin on the natural flood plain.

Perceptions of Stormwater Management Techniques

The stormwater management proposals for the two areas were:

- the construction of an on-line retention pond within Sandyhills park, which would receive runoff from the surrounding area through swales;
- the construction of a balancing pond in the Tollcross area, which would receive roof runoff from the McVities' Factory and street runoff via swales.

The participants in both areas were asked to evaluate the proposals. In both areas more than half of the participants were in favour of the suggested solutions as demonstrated in Table 6-3.

Table 6-3 Preference over suggested plans

Restoration scheme	Percentage of participants
In favour of the suggested scheme	53%
Do not agree with the suggested scheme	20%
No opinion	27%

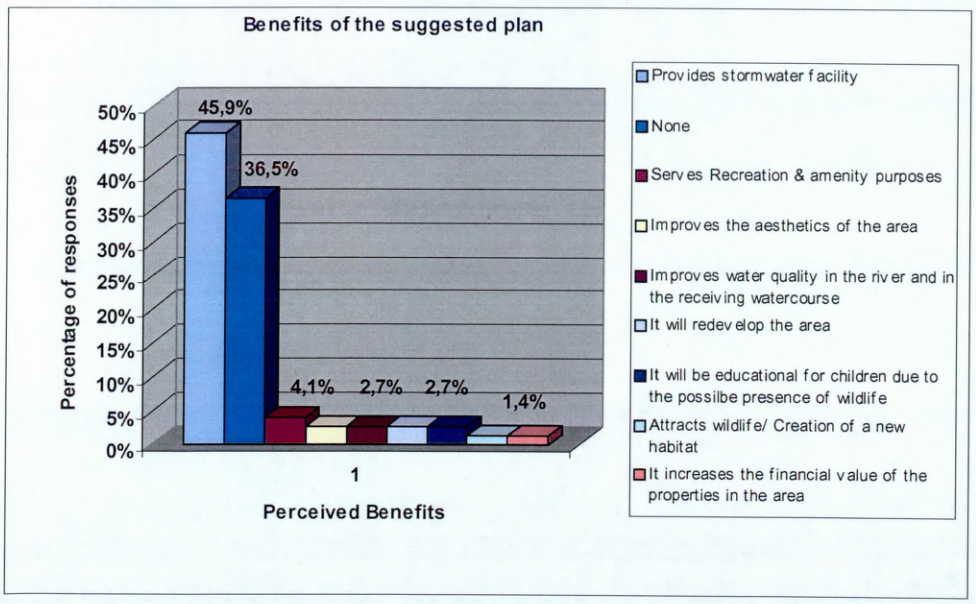
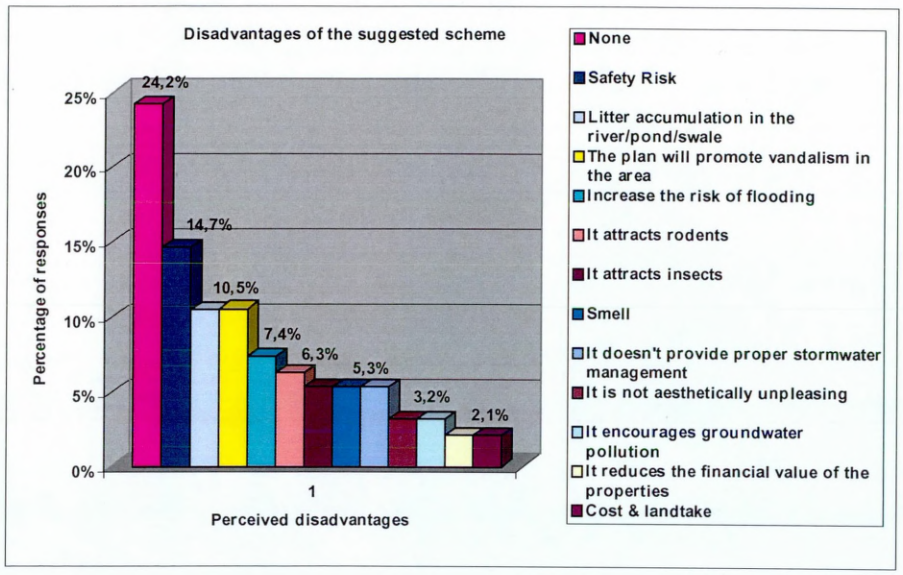


Figure 6-10 Perceived advantages of the suggested plans

The main benefit of the solutions suggested by the participants and presented in Figure 6-10 is that the stormwater management facility provided for both strategies. *"It is a nice suggestion, it will protect us from flooding and I believe it will also look nicer. It will attract wildlife,*

ducks, and coots from the park. It should be nice and educational for children". However, more than 35% of participants could not identify any benefits of the proposals.

The participants also indicated numerous disadvantages of the strategies as shown in Figure 6-11. *"I'm afraid it will be badly vandalised, it will become a dumping site that no one will accept to maintain"*. The safety risk was perceived as the biggest disadvantage of the proposed scheme, although the majority of participants could not identify any disadvantages/concerns. The perceived safety concern was children drowning in the open parts of the river or in the retention pond.



However, most of the participants said they would still like to live in the area. They suggested that parents should educate their children on how to behave around open watercourses.

Figure 6-11 Perceived disadvantages of the suggested plans

Safety Concerns

When the participants were asked to rate different safety risks present within residential areas, the local stream was perceived to be safer than a natural river, a heavy road traffic scheme, and a landfill site and almost equally dangerous to a natural pond, as shown in Figure 6-12.

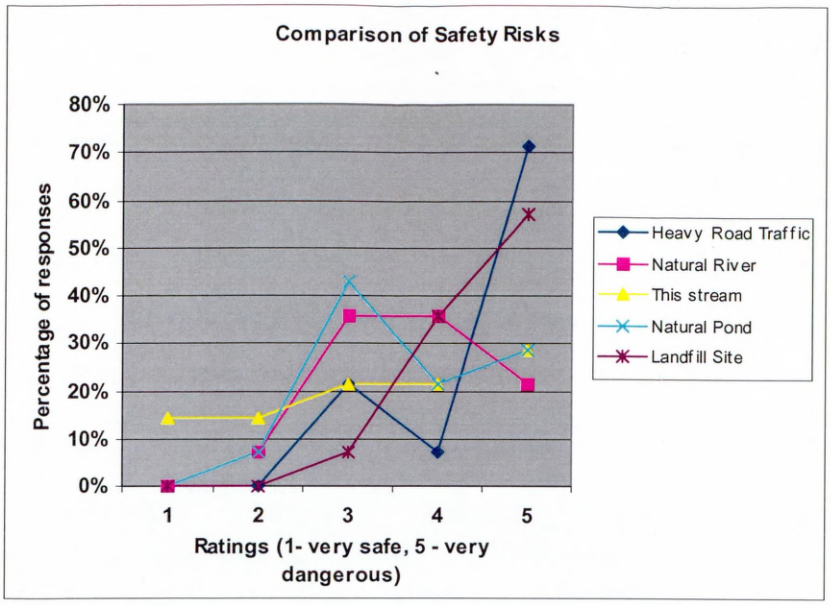


Figure 6-12 Comparison of safety risks present within residential areas

The majority of participants believed that the suggested plan was the most appropriate for the area. However, 32% of the participants suggested that the most appropriate solution for their area would be to improve and regularly maintain the existing drainage system.

Table 6-4 Alternative plan for Glasgow

Suggestions for an alternative plan	**Percentage of participants**
No	57%
Improve and clean up the existing drainage system	32%
Don't know	11%

Public suggestions on improving the suggested plan

The main suggestions made by the participants in relation to either alternative plans or improvements to the proposals were frequent maintenance and unclogging of the drains and sewers and the cleaning up of the river banks on a regular basis to avoid flooding. *"No one wants the responsibility of cleaning up the place; still this is the most crucial thing"*.

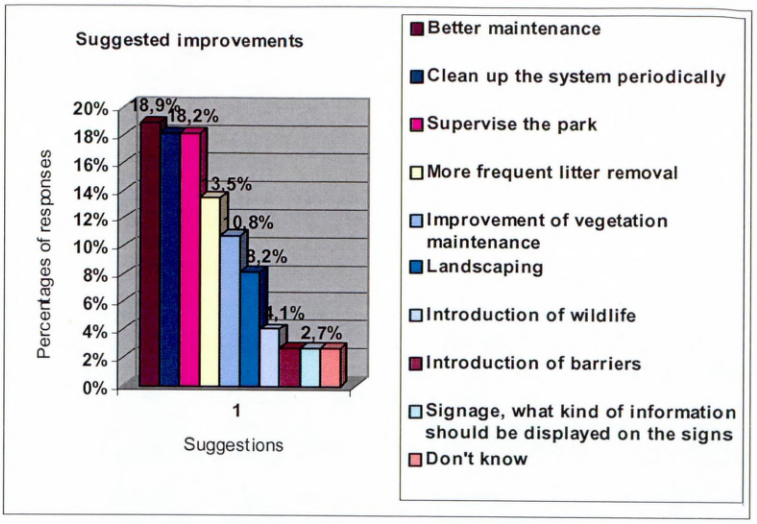


Figure 6-13 Suggested improvements for the area

Landscaping of the area and the introduction of wildlife to Sandyhills Park were also mentioned. *"Make it look attractive and safe. Then we will use the area and encourage our children to take care of it. But how can you convince children to respect something ugly?"*.

Sustainability of the schemes in relation to other practices

The participants were asked to evaluate six environmentally friendly practices for two reasons: first, to compare the public perception of the improvement of streams to other environmentally friendly practices and secondly to evaluate the perception of the sustainability element of the proposed scheme. This comparison with other practices that are well recognised as sustainable or fulfil sustainability criteria provides an indication on how sustainable this scheme is perceived to be. The results are shown in Figure 6-14.

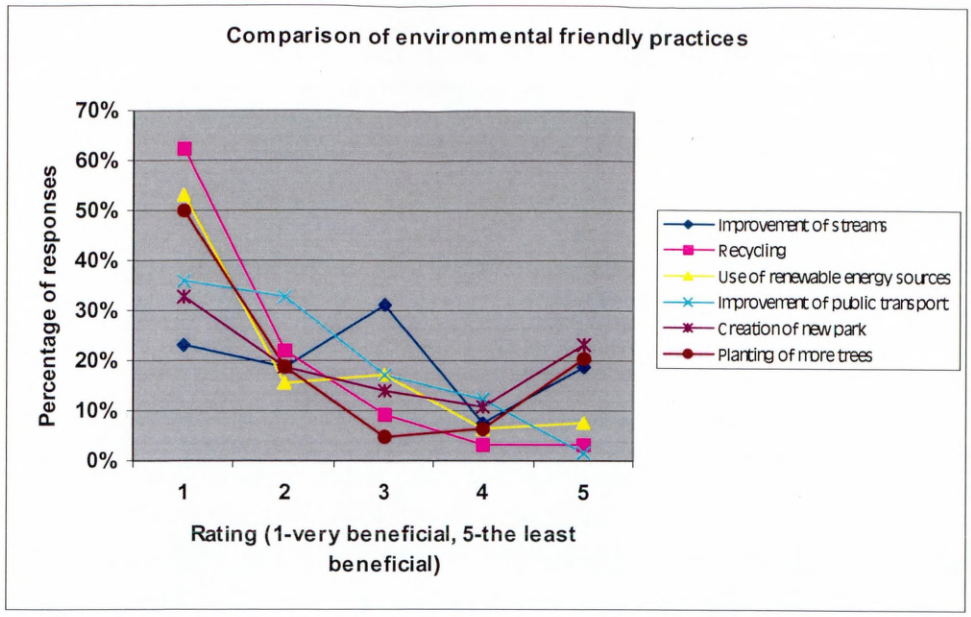


Figure 6-14 Comparison of environmental friendly practices

Public information and engagement in planning

The participants in the survey frequently suggested a need for public education about the scheme and involvement in the decision making and planning process. Towards the end of the questionnaire the vast majority of participants made a particular request to be informed of any future developments or relevant decisions to be taken regarding their area. They stated that the City Council should not decide or proceed with any decisions on their area without consulting them. This request was particularly strong from residents living near those roads which experienced the most severe floods. They were willing to participate in any type of consultation process and to be part of any committee for the planning flood protection and water attenuation systems in the area. Those participants felt that they were able to offer important local knowledge and ideas and that the council should not neglect their voice.

6.2.5 Focus Group Results

One focus group was held with local residents living at Strowan Crescent, Sandyhills, on the 31 October 2003, the main topic of discussion being the flooding at Sandyhills. The participants underlined the severe flooding problem of the area. A number of houses are seriously affected by flooding during every heavy rainfall event. The houses are located just

upstream from the entry point of a culvert. During heavy rainfall events the road drains overflow.

"Water mixed with sewage runs from the drains back to the stream, which eventually floods into our houses". Those residents affected by the flooding expressed grave concerns over hygiene when sewage mixes with the water. The residents complained about the inadequate help they receive from the authorities during and after the flooding incidents, and about the fact that no action had been taken to reduce the flooding problem of the area. They were well aware that Scottish Water have responsibility for the sewers, the Road Authority is responsible for flooding on and from the roads, and the Local Authority responsible for flooding of watercourses.

Figure 6-15 Flooding in the front garden and the street at Strowan Crescent

However, in the case of Sandyhills, the flooding occurs both from combined sewers and the local stream. The relevant authorities try to pass the responsibility to one another and the problem has remained unresolved. One attempt to solve the problem by relining the drains was unsuccessful as it resulted in increased flooding due to the additional strain put on the road drains. The only action taken by Scottish Water after every sewage-flooding event is to spray the area with disinfectant to reduce the risk of infection! The locals take a dim view of this.

"I don't think that spraying the sewage with disinfectant solves the problem. This is ridiculous. Would those people from Scottish Water let their children play in a garden flooded with sewage if the sewage was just sprayed? Why should I feel it is fine for my family then?".

Figure 6-16 Emergency measures in Sandyhills

The participants also mentioned that the only emergency measure taken was to issue sandbags for preventing the water from flooding houses, as illustrated in Figure 6-16.

There are several implications from the flooding problem. Apart form concerns over hygiene and the inconvenience and psychological stress caused by flooding, there are also financial implications. Some residents had to restore their gardens, and one resident revealed that they had needed to landscape the back garden twice in 4 years.

> *"The estimates include costs for in one case laying land drains and in the other laying 40 tons of hardcore and lifting the entire garden level 12 inches" as the householder stated.....my gardens were completely landscaped at a total cost of £7,000....I am very angry to see my hard work floating in a pool of effluent 2.5 feet deep".*

The resident received £1,500 in compensation after spending £7,000 on restoring their garden. Residents of the frequently flooded properties only get an exemption from water rates for the period during which the flooding occurred. Additionally, it is likely that householders affected by flooding will be refused insurance coverage for their houses, making these properties impossible to be sold. As expected, local residents are seeking a permanent solution to their problem, which has occurred on an increasingly regular basis over the past 10 years.

The main suggestions from participants in the focus group were:

- Disconnect the stream and surface water from the sewers to stop drains from being inundated with this type of runoff. This would prevent sewage overflows;

- Regularly maintain and clean out drains and the river banks;
- Construct flood prevention facilities to collect rainwater, such as permanent ponds or to open up the river banks and deepen the riverbed.

> *"I believe that the current Victorian sewer cannot cope and needs to be replaced. We realise that the cost of such actions is high and maybe the City Council has other priorities but on the other hand it's vital for our living and well being. We are terrified every time it rains heavily, we are afraid that our houses will flood once more and our children will be exposed to effluent, we are highly concerned for our hygiene".*

6.2.6 Summary of main findings

Overall, there is serious concern with flooding issues in the area and with pollution in the Tollcross Burn since the stream becomes becomes contaminated with sewage during heavy rainfall events. As expected the participants in the survey were in favour of suggestions that could reduce the risk of flooding in the area and could also provide amenity and recreational facilities. They shared the opinion that landscaping the area and river restoration would not only resolve the flooding problem and improve aesthetics in the area but would also have a positive effect on property values and general improvement in the area.

The idea of bringing the stream back to its natural form was welcomed by most participants. The need for redevelopment of the area as part of the river restoration scheme was underlined in both survey areas. The participants shared the feeling that the aesthetics of the area should be improved and there should be appropriate landscaping and lighting in the surrounding park. This would make the area look tidier and crime, a major concern in the Tollcross and Sandyhills areas will reduce. They believe that when an area looks abandoned and has no signs of supervision, it becomes the right setting for criminal activity.

The main findings of the survey in Glasgow are summarised in Table 6-5.

Table 6-5 Summary of outcomes

Group of questions	Outcome
Environmental Awareness & Concerns	Low levels of environmental concern
Public Awareness on the Flooding issue	High concern over flooding
Perceptions of suggested stormwater manage scheme	Positive attitudes towards the suggested plan as long as it resolves the problem of flooding and is properly incorporated in the existing park, in matters of safety and aesthetics
Safety Concerns	Some safety concerns exist. However concerns are lower than the perceived risk of flooding due to the inadequacy of the existing scheme.
Suggested improvements by the public	Suggestions were related to improved maintenance and frequent cleaning up of the existing stream and park as well as supervision of the surrounding area to reduce crime.
Sustainability of the suggested stormwater management plan	Responses indicate that the suggested plan is perceived equally sustainable to planting of trees.
Public Information and engagement in planning	Strong request for the public to be consulted and involved in planning

Gender-based and age-based analysis of the research results demonstrated little differentiation of perceptions between genders and among the different age groups. These types of analyses are attached as Appendix III-B for reference.

6.3 LONDON PROJECT

6.3.1 Site Background Information

The River Brent is one of London's principal streams which joins the River Thames at Brentford. It is a heavily urbanised catchment and covers an area of 173.5km^2 in northwest London. The area includes Tokyngton Park and the Wembley Industrial Estate (River Brent Enhancement Project, 1999). The waterways of Brent are shown in Figure 6-17.

Figure 6-17 Waterways in Brent (http://www.bb-environment.org/Brent%20Water/index.htm) © Brent Council 2004 Legal

Before the area was urbanised in 1875, the river was much larger than today, accommodating water up to 1.5m deep during dry seasons, and 3m during wet seasons, raising to 4.2m during extreme rainfall events. In the late 18 Century the quality of water in the river was very good and it was used by local residents for fishing trout and pike. The waterway was straightened into a deep U-shape concrete channel in 1947, immediately after the Second World War. Further works were undertaken to the river in 1988/1990 with the surrounding park being used as a flood storage area.

The area was always prone to flooding. The worst flood incident in the area occurred in 1840 when, after a week of heavy rain, the dam at the Welsh Harp, the local reservoir, burst its

banks and several people drowned. In 1886, partly treated sewage from the Willesden sewage farm at Brentfield Road was connected to the drainage of the area (Anon. Hell and High Water, **www.bb-environment.org**). In 1911 the situation improved when the Willesden sewer was connected to the London County Council sewers. In August 1977 another flood hit the area and more than 200 houses, numerous factories, shops, and schools flooded under 1.5m of water (Anon., River Brent Enhancement Project, **www.brent.gov.uk**).

The area around Tokyngton park, the focus of the current research programme, is of medium to lower socio-economic background. A river restoration plan is currently being implemented in the area. The first phase of the plan is complete and Brent Council is now developing the second phase. The river restoration strategy aims to:

- provide better flood prevention for the surrounding area;
- improve the river's surroundings for aesthetic and amenity purposes;
- improve water quality in the river;
- provide opportunities for recreation and leisure for local residents;
- reduce crime via landscape improvements .

To date development includes several major changes to the park. A section of the concrete channel has been filled in and replaced with a meandering river while maintaining the existing level of flood prevention. This plan encourages wildlife and enables access to the river. The surrounding area has been cleared of vegetation apart from a woodland area and a 75m gabion wall has been constructed allowing the creation of new cycle paths by the river. A new footbridge has also been constructed to create an additional crossing point and an alternative route for local residents. CCTV cameras have been installed to reduce crime. Hundreds of trees and plants have also been planted in the park and benches have been introduced at selected locations. Other changes in the park include litterbins, a new playground area, pieces of public art by local artists, and information boards detailing the changes to the park. A map of the new features is included as Figure 6-18.

Figure 6-18 Map of new features in River Brent. (http://www.brent.gov.uk) © Brent Council 2004 Legal

The current appearance of the river and the surrounding area after the first phase of the river restoration plan was completed, are presented below.

Figure 6-19 River Brent

Figure 6-20 Open part of River Brent

Several features were introduced to enhance amenity in the surrounding park. Such features include new playground areas, new walkways and cycle ways as well as art works by local artists including a mosaic used as a small roundabout.

Figure 6-21 New playground in the park

Figure 6-22 Walkways in the park

Figure 6-23 New Mosaic in the park

A public perception survey in 1999 showed that the majority of local residents were in favour of the improvements. 7000 copies of the questionnaire were distributed, with the purpose of assessing opinions on river restoration and landscaping of the park. The results of the first questionnaire showed that the public were in favour of opening up the river and increasing the amenity of the surrounding park. Most residents believed that the river was ugly before the restoration and approved of returning the river back to its natural form. This would improve the aesthetics of the area and encourage the locals to use the park more frequently. The main suggestions for the surrounding park included cleaning up area, improvements in lighting, improvement to water quality, installation of more litterbins, creation of picnic areas, and planting of more trees and flowers. The creation of cycle routes and footpaths was also mentioned and the importance of maintenance of the area was underlined (Brent River Enhancement Project Report, 1999).

6.3.2 Review of the Flooding Issue

The local press took great interest over the project and a local newspaper article produced a computer-generated picture of what the transformed river would look like. This was shown to residents of the area who were then asked to give their opinion. Responses included:

> *"I had no idea that we had a river in Brent, but this sounds like exactly the kind of thing the Council should be spending our money on. It would create a nice relaxing area for local people and visitors, particularly families"* (Park Life).

> *"Oh you mean the horrible, smelly stream that runs by the North Circular? If that's a river then it's a real waste of a good facility. I would support any proposal to make it look like it does in your picture and once it's finished I'd spend lots of time chilling out down there with my four year old daughter." Or "This is a great way of taking full advantage of a natural feature of the area. There is enough green space around here to turn it into a haven for wildlife and a common ground for two communities that live either side of the river. It should have happened years ago"* (Park Life).

One article in the 'Observer News' refers to the fact that it is up to the locals to decide over the river restoration plan for the area. In the same article, Ian Bellia, the council's lead member for the environment states:

> *"We are keen to attract more animal and plant life back to the river's banks in an effort to restore a more natural environment" and he continues "this will greatly enhance the amenity for the local residents".*

Another article refers to the fact that Brent Council planned to spend £1.3m to revitalise the river. In the same article there is also reference to the fact that 77% of the participants in the Brent Council postal survey of attitudes in 1999 favoured the idea (Observer News, 2000 and Observer News 2001). The initiative of 30 volunteers to clean River Brent's surroundings in October 2003 was made in the neighbouring burgh of Harrow. As Joyce Ip from Brent Council wrote in the article

> *"Not only is litter an eyesore, but it also creates an environment that promotes further crime and vandalism.... We want to keep the area clean so that once again it can be safely used by the community"* (Harrow, 2003).

6.3.3 Overview of Results

Overall, the majority of the participants agreed with the river restoration work in their local area. As expected, the majority of public concerns expressed were about over safety, however, this was not so important that it put residents off from approving the proposals.

The structure of the door-to-door questionnaire and the survey methods were the same as in Glasgow and although some answers were included in the questionnaire, they were not shown to the public, thus avoiding biased answers. Results are presented per question or per group of questions beginning with questions on general environmental issues and continuing with more specific questions regarding preferences of stormwater management techniques for each area. Gender-based and age-based analyses were also carried out and presented when there are differences related to the gender or the age of the participants.

6.3.4 Results per Group of Questions

Environmental Awareness, Concerns and Water Quality

Low levels of awareness about general environmental issues were identified. Almost half of the participants (45,8%) stated that they had no environmental concerns. The most common environmental concern stated by the participants was water pollution (17%), air pollution (16%), and the disposal and treatment of solid waste (9,6%). The results are presented in Figure 6-24.

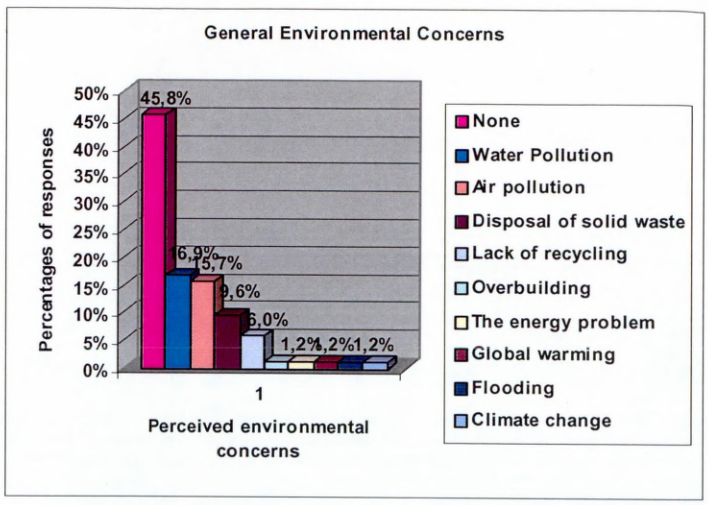


Figure 6-24 General environmental concerns

In addition, about 25% of te participants in the survey believed they have no personal contribution to water pollution via drains.

Amongst those who recognized their personal contribution to water pollution, 17% believed it to be via the disposal of solid wastes down road gullies. Other activities identified as contributing to water pollution were toilet waste, domestic washing, oils & fats originating from house drains. The results are presented in Figure 6-25.

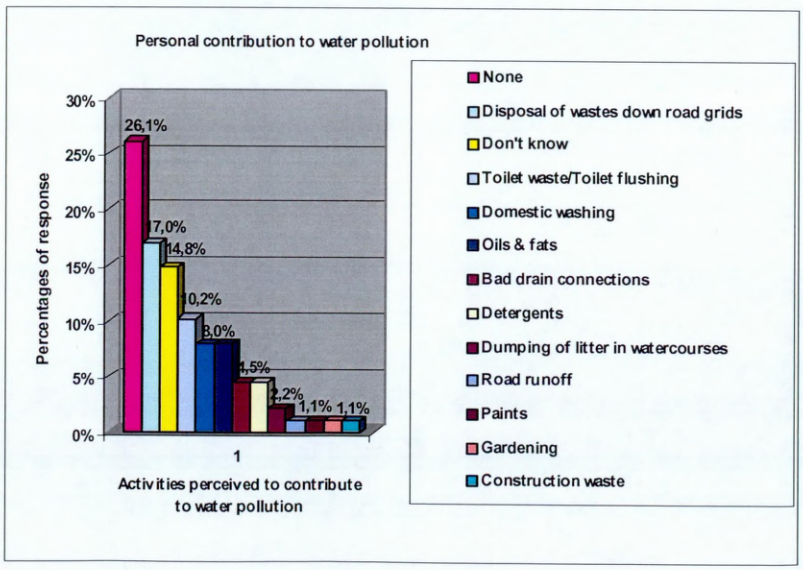


Figure 6-25 Personal contribution to water pollution

In the River Brent area very low levels of awareness of the existence of the stream were identified. Only just over 20% of respondents were aware that it drains to the River Thames, while the rest of the participants could not indicate the route of the stream.

About 40% of the participants stated that they were not concerned over pollution in the stream. The ratings of water quality are described in Table 6-6.

Table 6-6 Rating of the stream's water quality

Rating	Percentage of Participants
1: Very satisfactory	1%
2: Satisfactory	8%
3: Not excellent but still not dirty	40%
4: Polluted	35%
5: Highly polluted	16%

The main methods suggested by participants for improving water quality included improvements in public education to avoid littering of the river, and regular maintenance and tidying up of the river. Some residents also suggested the introduction of waste bins close to the riverbanks to discourage people from dropping litter in the vicinity of the river.

Public Awareness of the Flooding Issue

Tokyngton Park, is in a natural flood plain. However, although there have been several incidents when the park has flooded, flooding of residential properties is uncommon. About 40% of participants indicated that flooding has occurred in the area once or twice approximately 15-20 ago. Consequently, flooding in the area is not a major concern of the residents.

Perceptions of Stormwater Management Techniques

Most of the participants (60%) stated that they are in favour of the river restoration works that had taken already place in the area. Their opinions was that the works were a positive development for their area. Their preference towards the scheme is given in Table 6-7.

Table 6-7 Preference over suggested plans

Restoration scheme	Percentage of Participants
In favour of the river restoration scheme	60%
Do not like the river restoration scheme	21%
No opinion	19%

The detailed results of this question are presented in Figure 6-26.

The main perceived benefit of the river restoration plan was the fact that the purpose of the was to improve both recreation & amenity and also that to improve the aesthetics of the area.

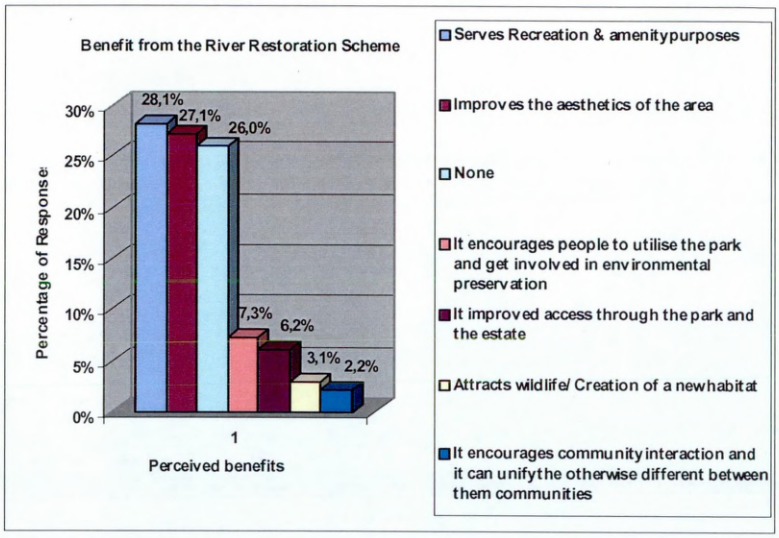


Figure 6-26 Perceived advantages of the suggested plans

"The river restoration plan is an improvement for the area. It increases amenity and encourages people to use the park for recreation".

Surprisingly, another 26% of the participants believed that the plan had no advantages for their area and about 40% of the participants in the survey believed that the river restoration works had no disadvantages for their area.

Approximately 25% of participants who referred to disadvantages stated that the safety risk of open water is their main concern related to opening out the river.

All the perceived disadvantages are shown in Figure 6-27.

"Vandalism in the river and crime issues worry me the most".

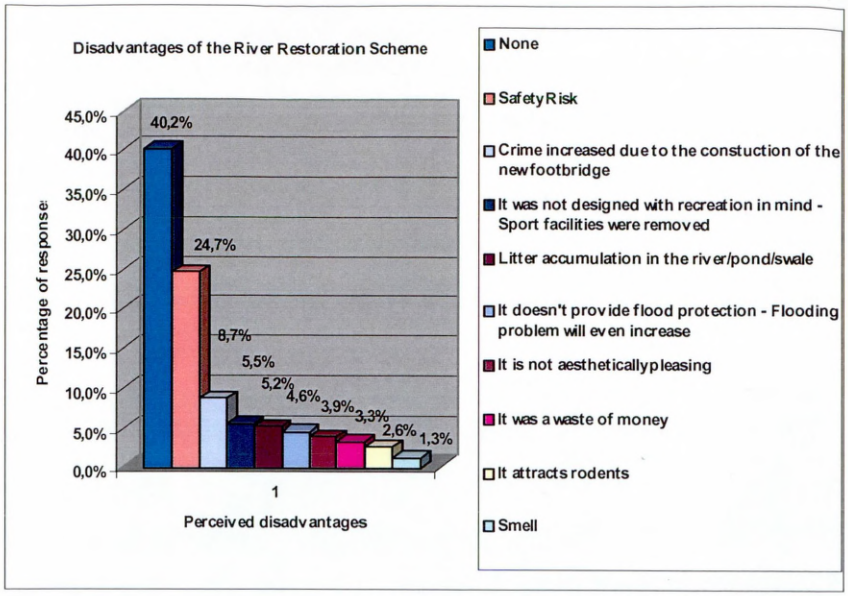


Figure 6-27 Perceived Disadvantages of the suggested plans

Amenity

The participants who mentioned recreation and amenity among the perceived advantages of the river restoration plan were additionally asked to clarify what they meant by the term amenity and what it meant to them. The result was that amenity in the respondents' minds is associated with recreation, leisure, environmental benefits for the area and the creation of facilities available to the public. *"Amenity includes a lot of things; it reflects the environmental benefit for the area, the leisure and recreational facilities available. It represents something nice, beautiful".*

Safety Concerns

At this stage, concerns surrounding increased crime levels should be clarified. Residents believed that the construction of a new footbridge over the river would increase crime levels due to easier access to the housing estate from outsiders who could commit several crimes in the area and then use the footbridge as an easy escape route.

The other major safety concern was the possibility that children might drown in the open parts of the river. However, most participants said they would still like to live in the area and they would educate children to be were aware of how to behave around open watercourses. They

added that parents and schools should teach children the benefits of having a river in their area while at the same time underlining the dangers involved so that children could learn to enjoy nature without exposing themselves to the risk of drowning.

> *"If a child falls in the river things may get ugly, but this is not an excuse for asking to take the river away. We should teach the children at home or at school of the dangers involved with playing close to the river. In any case, very young children, who are those most in danger, shouldn't be left unattended close to water in general. If they are left alone then it is the parents' fault, not the river's".*

Compared with other safety risks within residential areas, the local stream was perceived to be the safest. It was characterised as having the same potential for danger as a natural river, as shown in Figure 6-28.

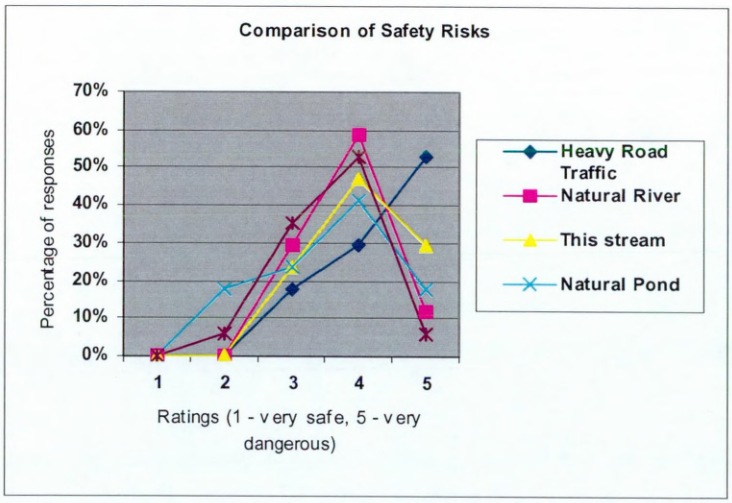


Figure 6-28 Comparison of safety risks present within residential areas

Public suggestions on improving the river restoration plan

The vast majority of the participants were in favour of the river restoration plan and few were unable to suggest alternatives. The small number who offered alternatives referred to the surrounding area of the river and the creation of more amenities, and not to river management techniques.

The main suggestions to improve the existing plan and the surrounding area referred to recreation, amenity and safety within the park. Other suggestions to improve the look of the river and the park were also made and are all presented in

Figure 6-29.

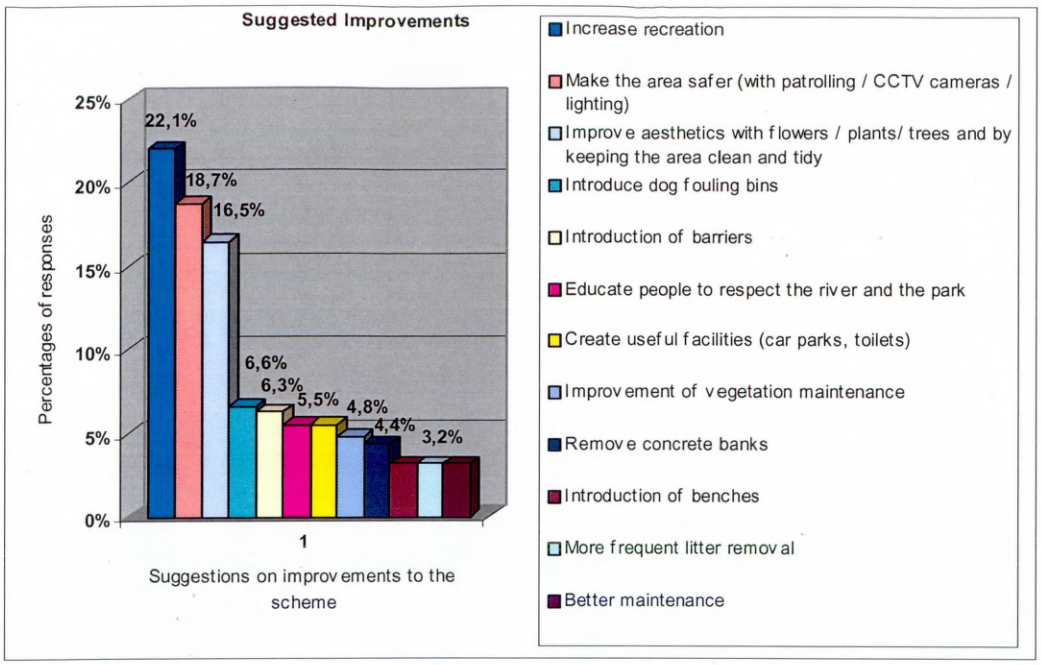


Figure 6-29 Suggested improvements for the area

Sustainability of the scheme in relation to other practices

The participants were asked to evaluate six environmentally friendly practices for two reasons: first, to compare public perception of the improvement of streams to other environmental practices, and secondly, to evaluate the lack of environmental awareness of the public in the areas of interest. The results are shown in Figure 6-30.

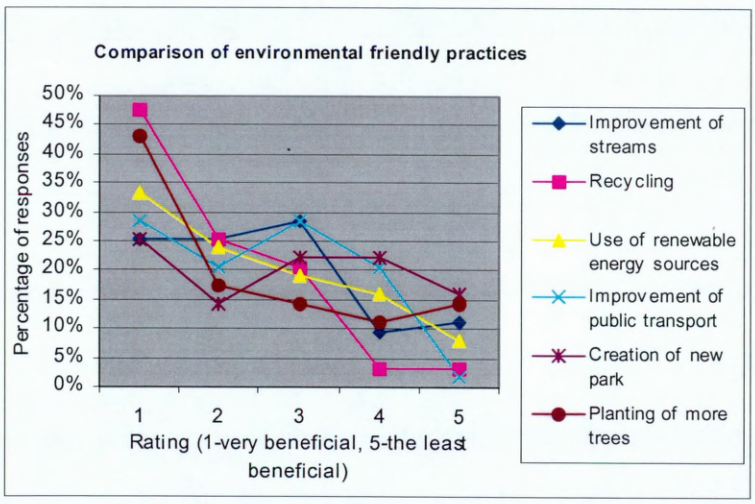


Figure 6-30 Comparison of environmental friendly practices

This evaluation provides evidence about the perceived sustainability of the improvement and restoration of streams because this development was considered to be beneficial by 25% of participants. This is equal to perceptions regarding recycling and the use of renewable energy resources, which are widely accepted as beneficial and viable sustainable practices.

Public information and engagement in planning

The river restoration and rehabilitation plan in Brent, known as the River Brent Enhancement project, materialised in 1999 after a public perception and awareness campaign had been undertaken in the area by the Brent Council. The public consultation identified the preference of the local residents for the river restoration plan and outlined suggestions by the public on how to make the plan more acceptable. As a result, and as was also found in the current perception survey, the majority of local residents are in favour of the scheme and of making use of the facilities provided. Members of the public who participated in the current survey made reference to their own engagement in planning the scheme and the vast majority stated that they were satisfied not only with the works that had been implemented but also with the fact that they had been a part of the process. The main objections to the plan focused on the fact that some participants felt that the council did not exactly deliver what they had expected.

However, it was found that they were more positive towards accepting the plan than residents of other areas who were not consulted at all. Residents in the area stated that they are keen to participate in any future consultation projects and are currently active in organising several events in the park, such as yellow-fish days, art exhibitions, and activities for children.

The positive attitude and their willingness to be engaged in the next phases of the river restoration project, which will include further improvement/rehabilitation of the surrounding park, is attributed to their actual involvement in the planning of the scheme at the very beginning of the project.

6.3.5 Summary of main findings

Overall, residents were positive towards the river restoration scheme that took place in their area. However, a few members of the public believed that opening out the river was a waste of money as they preferred the traditional method of treating runoff and the older practice of culverting rivers which run through residential areas since they considered this to be safer. Other complaints were; many participants believed that the council did not deliver what they had promised mainly in matters of amenity and recreation. Although the plan was recognised to have enhanced amenity, some residents expected even more benefits than those of the first phase. They stated that several sport facilities, which were removed from the park, such as football pitches, ball pitches & golf pitches, should be re-introduced. Many also suggested the

introduction of skateboard areas for teenagers. People believed that the park was more suitable for very young children or for the elderly and there were not enough activities for teenagers.

Attitudes towards the new footbridge, which connected the east and west parts of the park which is naturally divided by the river, were controversial. Some believed that the new pathway unified the community and created a shortcut through the estate, while others saw the new footbridge as being responsible for the increase in crime in the area, as it provides an escape-route for criminals entering the park area from other residential areas. Overall, the majority of the participants agreed that more work should be done on landscaping of the surrounding area, always with amenity in mind.

The main findings of the survey undertaken in Brent are summarised in Table 6-8.

Table 6-8 Summary of outcomes

Group of questions	Outcome
Environmental Awareness & Concerns	Low levels of environmental awareness and concern were identified.
Public Awareness on the Flooding issue	Flooding is not a major issue in the area.
Perceptions of the river restoration scheme	Overall the attitudes towards the existing scheme were positive.
Amenity	Associated to recreation, leisure and of environmental benefits for the area.
Safety Concerns	Some safety concerns exist. However people were in favour of the scheme, which was perceived as the less dangerous among the schemes in question.
Suggested improvements by the public	Suggestions were related mainly to aesthetics and increase in the amenity value of the area.
Sustainability of the scheme	Responses indicate that the river restoration plan is perceived equally sustainable to recycling, that is the sustainability element of the river restoration scheme is appreciated.
Public Information and engagement in planning	Strong request for the public to be involved in planning

Gender and age-based analyses of the research results showed little differentiation in perceptions between genders and among the different age groups. These types of analyses are attached as Appendix III-B, for reference.

6.4 ATHENS PROJECT

6.4.1 Site Background Information

The Kifisos is the main river running through Athens. It has a catchment area of 400 km^2, it is 24 km long and has 12 main tributaries (Mpitsika, 2002). The Kifisos, along with the Ilisos and its tributary stream the Iridanos have caused flooding in Athens since ancient times. Both the Iridanos and the Ilisos, which used to join the Kifisos where it flows into the sea, have caused serious flooding in the past. However, the Iridanos however was culverted in the 2nd century B.C.

Works on both the Ilisos and the Kifisos began many years ago. Works on the Ilisos began in 1936 and river culverting works began in 1948, leaving the city of Athens with one major open river. Additionally, out of the 750 streams, which ran through Athens in the 1960's, only 100 remain today, while almost half of the 24 km Kifisos river have been covered over (Linardou, 2002). Out of the 207,57 kilometres of open rivers in 1893, there were only 102,81 kilometres left uncovered by 1945, by 1973 there were 84,92 kilometres, and today it is only 44,50 kilometres of rivers and streams that have not been culverted in Athens (Mpitsika, 2003). At the same time urbanisation has dramatically increased in the area. In the 1940's there was an 8% increase, in 1950's there was a 10% increase, while today the urbanisation rate has reached 63%, all contributing to increase in flood risk (Votsis, 2002).

The Kifisos used to be a pleasant and clean river, and was so important for the city of Athens that it became a God in antiquity. It provided a recreational function until a few decades ago. As an indication of the cleanliness of Kifisos up, until as recently as the 1960s, locals fished in the river.

Figure 6-31 Fishing at Kifisos, 1958

Nowadays the Kifisos receives polluted waters from urban areas and industries and flsevere flooding, as shown in Figure 6-32. Although in a report to the European Commission, dated 19 June 1997, the Greek authorities claimed that the Kifisos received only clean water and

biodegradable substances (Terzis, 2003). Water analysis has shown that industrial wastes, in particular paints and tannery wastes, are discharged into the river. A representative of the Institution for the Environment of Municipalities of Piraeus and Western Attica stated in the newspaper Piraikos Aneksartitos that:

> *"Concentrations of zinc, copper, and other heavy metal substances have been found to be over the permitted limits in the Kifisos"* (Rapti, 2004).

To add to this, the local authorities consider the Kifisos to be part of the sewage system. The Greek authorities de-classified the Kifisos from being a river. This means that the current works will not be considered illegal under the European Law for rivers and streams and the Ministerial Decree for the protection of the Kifisos "Official Journal of the Greek Government -FEK 632/27.6.94".

In May 2001, the relevant authorities claimed that the Kifisos no longer receives rainwater and that it has become part of the sewage system draining to the Athens wastewater treatment plant (Psytaleia). However, a few months later the severe flooding of Kifisos due to heavy rainfall contradicted this (Terzis, 2003).

Figure 6-32 Flooding at Kifisos, 2002

When river engineering works at Kifisos commenced, the riverbanks were engineered to accommodate flows of 700 m^3/sec (Mpitsika, 2002). River works carried out in 2004 enclosed large sections of the river over which a four-lane motorway has been constructed. this is expected to carry about 150,000 – 200,000 cars in each direction per day (Aloniatis, 2002) (Figure 6-36 and Figure 6-37) and it is expected to increase the level of noise and pollutants in the area and to alter the microclimate. Property values in the area, which is of medium to lower socio-economic background and very industrialised, is also expected to reduce drastically as the distance between the new motorway and the nearest houses will only be about 9 metres (see Appendix III-D & Appendix III-E).

The capacity of the culverted river is 1100m^3/sec which may prove inadequate in extreme rainfall events. The 50-year return period flood was estimated, but this was based on data

collected in the 1980's when the area was not as heavily urbanised as it is now. No provisions were made for the impacts of global climate change.

TEE (the Technical Chamber of Greece) characterised the works at Kifisos as fragmentary and harmful, claiming that the original plan for rehabilitating the river was not followed (TEE, 2002a; TEE, 2002b). There has been extended reporting of the current works at Kifisos in the press and this is attached as Appendix III-D.

However, since no works outside the line of the river were undertaken, a hydraulic study alone was considered to be satisfactory.

Figure 6-33 Works at Kifisos, 2003

Figure 6-34 Works at Kifisos, 2004

During the recent works at Kifisos, remains of the "Long Walls of Athens" were uncovered. These 'walls' were used as a stone road connecting the ancient cities of Athens and Pireaus when the natural floodplain area in between the cities was immersed in river water. To date, this ancient monument has received no protection, despite petitions against the works at Kifisos by the Archaeological Society of Greece.

Figure 6-35 Covering of Kifisos and part of the "Long Walls"

Figure 6-36 Kifisos River before culverting

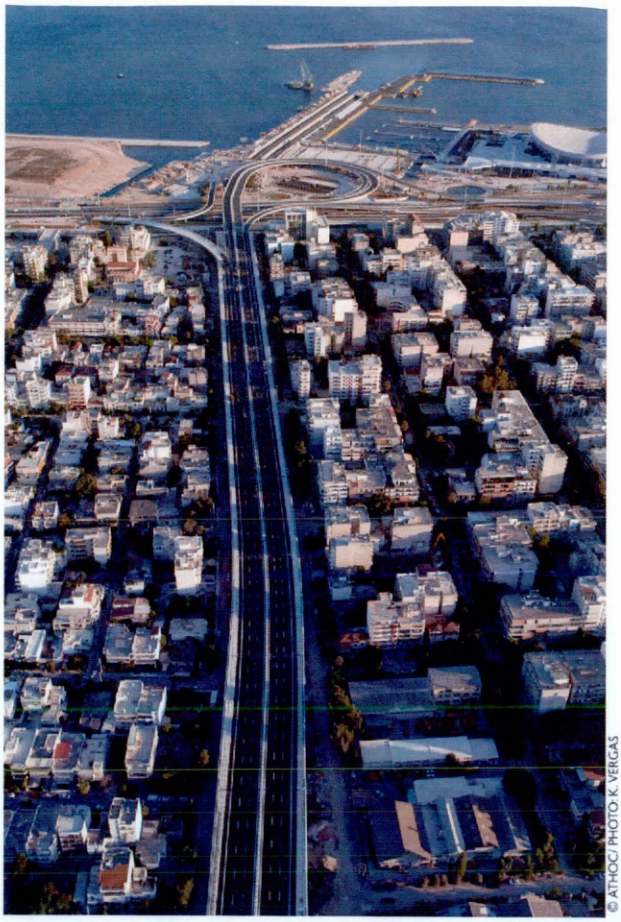


Figure 6-37 Kifisos River after culverting

6.4.2 Review on the Flooding Issue

There has been extensive press coverage on the flooding issues in Athens. Issues in the local press have included: flood incidents in Athens and the consequences for city life, the works at Kifisos and critical reviews of the works from experts and the public.

Flooding in Athens is not a recent problem and has been an issue since ancient times. However, the situation has deteriorated dramatically in recent years due to an increase in urbanisation and culverting.

The main flood incidents in greater Athens are presented below in detail. In November 1897, 35 people died due to flooding at Ilisos, while the big plague that hit the city in 1847 and caused the death of about 4000 people was considered to be the result of infection from contaminated water due to flooding from both the Ilisos and the Kifisos. (Krikis - Adamopoulou, 2002). In 1961, flooding killed 44 people died and 3800 were made homeless (Ireiotou, 2002).

Figure 6-38 Flooding, 1961

In 1977, 29 people lost their lives due to the Kifisos flooding in the area of Peristeri, the culverting having already started at this time. Due to the extensive drought in Athens between 1979 and 1993, no action was taken to improve flood prevention in the area (Tzanavara, 2002). It was only after 1993, following more severe flooding incidents, that Kifisos came back into the spotlight (Ireiotou, 2002). The river flooded at least once a year between 1993 and 2003 and in 2002 there were 4 major floods.

Since 1993, the most severe flood incidents include:

- November 1993: Hundreds of people were made homeless in the southern suburbs of Athens;
- January 1994: 2 people died and hundreds of people were made homeless in the northwest suburbs of Athens;
- October 1994: 3 people died and great damage was caused to properties;
- March 1998: A hundred families were made homeless in the northwest suburbs (Ireiotou, 2002);
- 20 November 1998: Severe flooding occurred in the area of Marathon which experienced 104 mm of rain. The flooding incident is believed to have been caused arson in large areas of forest (Hatzidis, 1998);

- 21-9-1998 – Southern suburbs of Athens (Glyfada) flooded;
- 14-10-1998 – Southern suburbs of Athens (Glyfada) flooded;
- 24-11-1998 – The extended region of Athens flooded;
- 7-10-2000 – Severe floods occurred in Athens' city centre;
- 20 November 2000: Western and northern suburbs of Athens were severely flooded. In total, the fire brigade received over 300 calls for help, while the army provided help in the flood affected areas (Anon., 2000);
- 5-11-2001 – Severe flooding occurred in Athens city centre;
- 8/7/2002 – Severe flooding in the southern suburbs close to Kifisos. One man died trying to save his young child and two women were injured. Local residents accused the authorities of not taking appropriate precautions while undertaking the culverting works which they believed to be the reason behind the severe flood event (Stergiou, 2002). During this event, over 1000 houses were destroyed and over 3000 people were made homeless, while several metro stations were also flooded. (Ntaliani, 2002).
- 18/8/2002 – Severe flooding around Kifisos, during which a total of 2543 calls for inspections at houses and help were made to the fire brigade (http://www.rizospastis.gr, 2003).

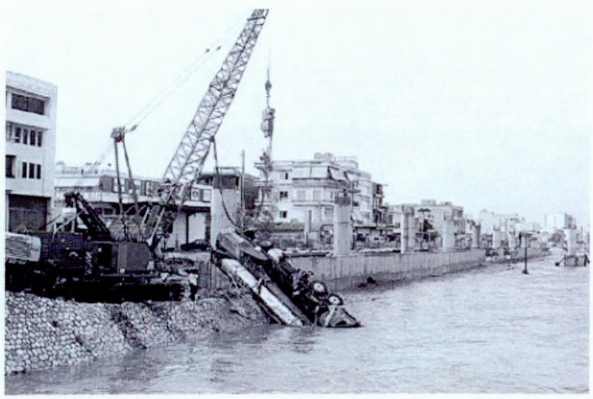


Figure 6-39 Kifisos River, 6 days after the severe flooding of 8/07/2002

Figure 6-40 Flooding in August 2002

- On 3/9/2002 and 4/9/2002, Houses and shops were flooded in several areas near the banks of Kifisos. Emergency measures, sandbags placed on the banks of the river, were proven inadequate to prevent flooding of the premises. Compensation of up to 4500 Euros for the damages caused by flooding was promised to those householders seriously affected. However, local residents were furious as the damages to many of the houses and shops exceeded by far the amount of compensation promised. They were also concerned by the fact that the same area flooded 3 times in 45 days. Flood incidents also occurred at the western suburbs and in the city centre of Athens, where a bus with 50 passengers was trapped until the fire brigade was able to help people escape to safety (http://www.in.gr, 2002) (Anon., 2002).

Figure 6-41 Emergency measures, August 2002

Figure 6-42 Flooding on 4/09/02

Local residents protested by closing several main roads in Athens for two hours on the 5th and 6th of September. They demanded more careful planning of flood prevention works in the area.

Attitudes to the works at Kifisos and press coverage and other coverage is attached as Appendix III-D.

Figure 6-43 Public protest on 6/09/02

Residents affected by flooding and by the works at Kifisos, had demonstrated their opposition to the works by demanding for a more permanent solution to the flooding problem of the area forming a pressure group called "Kifi-SOS". This group openly opposed the works at Kifisos, and published a series of articles in the press and a number of reports highlighting the problem to the Council of the State and to the European Commission. One report sent to the European Commission is included as Appendix III-E.

6.4.3 Overview of Results

Several individuals were approached for the semi-structured interviewing as described in section 6.1.2. Interviewees included academics and consultants with interests in stormwater management planning, members of city councils, and members of the public affected by the flooding or by the ongoing works.

The vast majority of participants believed that the works were inappropriate for the area. They gave two main reasons. Firstly, to culvert a river as big as Kifisos was considered as *"unsustainable"* and *"anachronistic"*, and, secondly, the current works on the river will not provide appropriate stormwater management for the area. However, some respondents expressed the opinion that, although they did not agree with this solution they realised it was the only feasible one at this point in time, as mistakes in the management of Kifisos River began about four decades ago, and all works that have taken place since then are irreversible. They described the situation as a *"one way road"* and hoped that the authorities had taken into account the negative results of their actions and will not adopt similar solutions for the upper, open, part of this or any other river in the country.

6.4.4 Results per Question/Theme

All participants stated that the river is very polluted not only with biodegradable but also with waste from industries along the river. They also added that there is aesthetic and chemical pollution, and that up to now no serious actions have been taken to stop small industries from disposing their waste into the river.

Environmental Awareness, Concerns, Water Quality, & Perception of the scheme

All participants were aware of flooding problems in the area. Flooding of Kifisos is one of the main problems facing Athens with extensive press coverage.

It is commonly accepted that the new works at Kifisos is mainly a road upgrade project and not a stormwater management scheme. Participants believed that the road works took priority over flood prevention considerations. Planners believed that they could solve both problems with one scheme, so promoted the culverting of the river and the construction of a motorway above. Traffic experts, not hydrological experts, were allowed to take the lead in planning the scheme.

The vast majority of participants believed that Kifisos "*should have been kept as a river*", and that culverting was not at all sustainable. One engineer stated that "*Kifisos used to be a nice river which up until the '60s was used for recreation and fishing*". The works that have taken place were characterised by almost all participants as '*madness*', '*action out of time*', and *'an anachronistic solution'*, which *"is not used in any developed country any longer"*. They said that the concept was based on plans from the '60s, the first official report on suggestions for Kifisos being in August 1974. Data gathered in the 60's, when climate change was not an issue and when the level of urbanisation was much less, was used for the current plan.

Participants mentioned that the river, after completion of the construction works, will have the capacity to accept 1400m^3/sec flow, which is estimated to be the 1 in 50 year event. In hydraulic terms, the design is adequate given the circumstances. The construction is very robust, the channel is 4.5m deep and the base and sides are 1.5m thick concrete. However, it is expected that during very heavy rainfall events, excess water will flood onto the bridges at those sections where the river is culverted, with dramatic results. Drainage from new areas has now been connected to the river, and there will be a subsequent increase in surface water flows into the river. High walls have been constructed, but it was highlighted that open sections do not have bank areas and the river has not been enlarged in these areas, so the risk of flooding is very high.

The problem began back in 1985 when the culverting of a large section of the river between the area of Three Bridges and the Petrou Ralli Avenue, was allowed to go ahead. In the 1980s, Athens was not as heavily urbanised in these areas as it is now, much of this area close to the Kifisos was farmland, and planners did not take advantage of this situation. They could have used this land to enlarge the river and construct the motorway alongside the river but at a safe

distance from it. Despite this, building was allowed in the area around Kifisos and the land was sold at very low prices for both industrial and residential use. It was at this point in time that the situation surrounding the last big river in Athens became irreversible. As one consultant interviewed stated:

> *"The solution that was recently adopted is the worst possible for Athens but given the circumstances and the condition of Athens at the moment, is the only feasible one. Hydraulically wise the river is expected to perform very well but still the solution is wrong".*

Additionally, maintaining the culverted sections of the river is expected to be difficult, and blockages with litter are expected to increase the risk of flooding and potential for infection. Most participants are very concerned over hygiene and odour issues.

Participants mentioned that the motorway is constructed at the top of the river and located only 9m far from houses.

> *"It is an environmental hazard for the locals as it increases pollution dramatically (air pollution, light pollution, noise pollution) and it is directly in their faces. Additionally the property value in the area is expected to drop dramatically and local residents will be refused insurance coverage for their properties"* (Member of the public active within Kifi-SOS group)

Despite the point of view of locals and members of the community engagement group against the works at Kifisos, the works progressed despite open objection to the works. Initially, 67 members of the public and more recently 650 members of the public have signed declarations of objection to the works that have been sent to the Council of State. Some residents hope that this new plan will work and the risk of flooding will be reduced. However, there was little optimism that it is the right solution, and there was open opposition to the construction of the motorway over the river.

According to residents questioned, there are a number of reasons why they objected to what took place at the Kifisos River. These objections included:

- It doesn't provide flood prevention. The design used hydrological data from the '70s and did not account for current requirements or the local situation. Severe flooding is

expected at the sections where the river becomes culverted from an open channel and at the river Delta;

- Part of a historical monument was damaged and the cultural inheritance of the city was disrespected. The "Long Walls", walls surrounding the ancient city of Athens and preserved since ancient times have been destroyed to construct the new "Kifisos" highway;
- It is expected that the light, air, and noise pollution will dramatically increase in the area. The motorway is above the level of the houses and is less than 9 meters from the houses;
- There is a fear of accidents from heavily load trucks;
- House values in the area will dramatically decrease. The houses cannot be resold or insured.

In general, participants expressed the concern that there is no stormwater management master plan for Athens. Runoff from new areas connected to the River Kifisos should have been conveyed to other watercourses. Other water collection systems should have been developed. Twenty years ago, when the areas around Kifisos were undeveloped, the land around Kifisos should have been sequestered and the new road should have been constructed at a safe distance the river. Preservation of the river and widening of the channel could have accommodated the increased water volume produced by recent urbanisation and climate change. To construct such a solution today would be extremely costly, particularly for the compulsory purchase of properties and land.

Since a more sustainable solution was not chosen initially, the existing situation is unfortunately the only possible solution. One engineer said: *"Maybe and hopefully a couple of generations later people will realise the mistakes made and they will open up the river"*. However this would be very difficult as the motorway would need to be reconstructed at an even greater cost. *"The worst thing with the current plan is that it is practically irreversible. We should have adopted milder solutions construction wise, which would also have lower cost. The cost of this construction is humongous."*

Safety Concerns

Neither the experts nor the members of the public were concerned over safety issues with the open river. They stated that although safety is usually a matter of concern over open channels running through cities, it was never an issue at Kifisos apart from at times of extreme flooding. Athenians utilised the river for recreation and no accidents were ever reported. The general attitude of participants over safety is captured in the words of one member of the public:

> *"The river has been there for ever and accidents have never occurred. If water is a part of every day life then people are not afraid of it, they know how to live with open water bodies and they educate their children on how to behave near water. In Greece we are used to living close to water bodies and we actually love it, we see it as pleasure and we don't feel threatened by it. Safety concerns arise only when the river overflows. In normal conditions there was never an accident."*

Public and professional suggestions on the river management plan

Participants in the semi-structured interviews were asked to suggest alternatives to the current development, taking into account the needs of the local residents. The suggested alternatives included:

- Reduction in urbanisation and covering areas of the city by impermeable areas. This could be controlled through legislation;
- Reduction of runoff at source. This means source control through regulation, using water butts, permeable pavements, and above ground or underground water storage;
- Impact assessments to ensure that runoff remains at pre-development levels following new constructions;
- Water storage tanks, ponds with permanent water or ponds used for runoff detention;
- Open out the river by enlarging it and supporting the banks to avoid erosion.

Public information and engagement in planning

Both members of the public as well as the professionals interviewed agreed that local residents are disappointed that they had not been asked by the decision makers for their views about the Kifisos plan. The public in general feel that they should have been consulted prior to construction as it is they who must suffer the consequences of river culverting and the construction of a motorway above it.

The flooding risk is perceived to be greater than in the past and the motorway is seen as a hazard. In addition, local residents believe that property values in their neighbourhood have dropped, which subsequently prevents them from relocating. Their negativity is directly linked to the perception that all of these consequences could have been avoided if they had been consulted. They would never have agreed to the decision that has been taken. They believe that this decision is completely unsustainable, that it was highly political, and was taken with no regard for the local residents. They were not allowed to engage in the planning process even though they were very willing to do so and this caused great dissatisfaction.

6.4.5 Summary of main findings

The local press reported the public statements of experts and the personal interviews of local residents and other stakeholders which all agreed that the solution adopted at Kifisos was not desirable. Most people in Athens believe that the decision to culvert the River Kifisos was politically driven and was taken under the pressure of the 2004 Olympic Games. This decision was perceived by Athenians to have been targeted at resolving traffic problem of the city just for this event. The scientific community in Athens clearly opposed the idea of such a project. However, to some, this solution was seen as a way to "kill two birds with one stone". The flooding problem of the southern suburbs of Athens was solved while at the same time a solution was found for traffic congestion in the city since the newly constructed motorway now diverts traffic away from other traffic related problem areas.

In general, participants clearly preferred for more natural systems and the sustainable management of rivers, and they expressed the hope that the solution adopted at Kifisos will at least be regarded as a bad example and one to be avoided by all means in future.

The main findings of the survey undertaken in Athens are summarised in Table 6-9.

Table 6-9 Summary of outcomes

Group of questions	Outcome
Environmental Awareness & Concerns	High levels of concern over pollution of the river.
Awareness on the Flooding issue	High concerns over flooding, a major issue in the area.
Perceptions of the river culverting scheme	Overall, the attitudes towards the river culverting scheme are very negative.
Amenity	There is no amenity element related to the scheme.
Safety Concerns	There are no safety concerns related to open water within the city, there are high concerns related to danger from flooding.
Suggested improvements by the public	Water conveyance to supporting schemes such as ponds.
Sustainability of the scheme	It is perceived non-sustainable.
Public Information and engagement in planning	Strong request for the public to be involved in planning in future development and big disappointment for the existence of no public consultation prior to planning.

6.5 DISCUSSION ON THE COMPARATIVE STUDY

The three areas considered in the comparative study have similarities that allow for comparison of the results. All three areas were of medium to lower socio-economic status within suburban areas of large multinational cities: Glasgow, London, and Athens. The areas selected were all affected by flooding and there was an urgent need for stormwater management techniques to be put in place. As a response to flooding issues, river management options had either been implemented or were under consideration. However, the plans which were either proposed or implemented differed between the three areas, from river restoration and retrofitting of SUDS to river culverting.

The comparisons of results from the three survey areas are presented in detail in previous sections and summarised in tables 6-5, 6-8 and 6-9. The results not only indicate similarities in perceptions but also assist in providing conclusions on preferences and trends in perceptions. A common outcome in all survey areas was the clear public preference towards natural looking schemes, with high aesthetics, amenity, and recreational value. Overall, the public, as well as the professionals interviewed preferred the use of sustainable practices in river management or

other types of stormwater management over traditional techniques such as the culverting of streams.

Aesthetics and function of systems appear to be the main concern of the public in all study areas. River restoration is considered as a particular main priority for the community in areas where severe flooding is experienced, as in the case of Glasgow. On the contrary, the option of river culverting, as in Athens, was considered inappropriate by most participants who believed that more environmentally friendly stormwater management options should have been chosen for the area. Overall, the sustainable management of natural sources, including river restoration, is gaining ground over traditional practices such as river culverting, which in most cases does not take into account environmental or societal factors. River culverting is also perceived as a bad practice where excessive volumes of runoff during heavy rainfall events are expected.

The comparison of attitudes and perceptions over safety in the three study areas highlights the importance of education in generating public attitudes. In areas where they were better informed or were involved in the planning process, individuals tended to express more positive opinions towards the schemes and were found to be less concerned over issues as sensitive as safety. These results are also in agreement with outcomes from the public perception surveys of SUDS. In Athens, where the river is the biggest of the three in question, people were much less concerned over safety issues from drowning than in the other two areas. Since participants believed that the river itself is not and never was a problem, this attitude has been formed mainly by how people behave around a watercourse and is something that can easily be taught to young people. Participants believed that people should behave around rivers or other types of open watercourses within residential areas, in the same way that they behave around natural rivers, ponds or the sea. People living close to water, even a river, consider it to be a part of their lives and, apart from cases of extreme flooding, they do not worry about it. Respondents clearly stated that safety is more a matter of perception rather than an actual risk. Of course, the difference in perceptions over safety can be explained as a matter of differing priorities. The severe flooding in Athens is considered by the public as the major safety hazard in the area and is definitely deemed as more risky than the mere existence of an open river.

The importance of public consultation prior to construction has been shown to increase acceptability of the applied schemes. In all areas the participants were most willing to express their ideas and concerns about the schemes. They were happy to participate in the planning

process as they are the ones who have to live with the new schemes and most of the time they have already thought of ways to improve their surroundings. In the two Glasgow areas, the public hope to be consulted in the future before any stormwater management plan is decided upon and implemented. In the Brent area, the majority of the participants were satisfied not only with the works but also with the fact that they had been consulted in advance of the river restoration scheme. Although some residents blamed the Council for bad management of the finances available for the river restoration project, they remained positive towards the scheme. On the other hand, in Athens, where the public felt that their ideas and needs were ignored, people were very disappointed and their opposition will possibly have political repercussions.

7 INTERPRETATION OF RESULTS

"...Ithaca offered you this great journey. You would have never got on the road if it weren't for Ithaca..."

— Kavafis, 1911

7.1 INTRODUCTION

Interpretation of results in this chapter adheres to the same aims used in the thematic analysis engaged throughout this thesis. Discussion of the results makes use of the issues in the literature (Chapter 2) which are important for this research work. These sustainable stormwater management themes are central to the adoption of SUDS and river management techniques. The different ideas and results are brought together in this chapter - contemporary trends in ideas for urban landscape and public engagement practices are presented in Chapter 2, and the results of the research programme are presented in detail in Chapters 4, 5, and 6. The relationships identified have provided a sound basis of understanding how attitudes on stormwater management practices are formulated and the factors which influence the development of ideas and current trends in urban design. The results of the research are applicable to urban design and are of particular interest to policy makers and stakeholders.

Proposals by participants regarding improvement of performance, function, and the methods to increase acceptability of the schemes examined are also summarised in this chapter and their feasibility for implementation have been critically evaluated. Barriers to the use of above ground drainage components such as SUDS ponds and river restoration schemes, are also included.

7.2 IN-DEPTH INTERPRETATION OF RESULTS

The recognition of the importance of public involvement in the planning process was one of the main motives for undertaking research into the social dimension of stormwater management practices. The results of the current work demonstrate trends towards environmental protection, perceptions of amenity, biodiversity, landscape preferences, safety, and adoption of sustainable systems in urban areas. Suggestions from members of the public on how to improve the

appearance and function of schemes in order to enhance public and stakeholder acceptability, have also been assessed. The ideas expressed by individuals have been used as the basis for making recommendations on improvements to schemes, and their promotion to stakeholders.

The results from the three years of research work are interpreted in the following sections which have the thematic structure adopted throughout this thesis.

7.2.1 Environmental Concerns and awareness of stormwater management practices

Although the research has demonstrated low levels of awareness concerning stormwater management, it has shown that the public is concerned over global environmental problems. The main environmental concerns identified by all public perception surveys were found to be air and water pollution, disposal of solid waste and global warming (Figure 4-5, Figure 6-8, Figure 6-24). At the same time the most members of the public considered themselves responsible for watershed pollution and they could even indicate the polluting activities in their everyday life (Figure 4-6, Figure 6-9, Figure 6-25).

Despite general environmental concerns and the understanding that everyday activities contribute to watershed pollution, low levels of awareness of the participants about the location and function of local stormwater management systems were identified in the surveys. This shows that little information which might influence their perception and concerns of urban design and developments is provided to urban citizens with respect to.

Public suggestions on how to increase environmental awareness were related to public education and are described in section 7.2.6.

7.2.2 Amenity

The importance of amenity for every day life and as a component of sustainable stormwater management systems is central to the findings of this research work. Amenity is strongly associated with natural-looking open water schemes which are designed to enhance recreation and leisure and is highly appreciated by the public and professionals alike.

Amenity in landscape design is often perceived as having the objective of diminishing the impacts of urbanisation in city environments, at introducing sustainable design and replacing

damaging technologies with more beneficial and sustainable ones, in this way minimising the consumption of natural resources and maximising environmental conservation (Johnson, in Thompson & Steiner, 1997; Laurie, 1997). It also encompasses ideas such as the re-creation of natural environments within cities and creating living environments which are acceptable to people, and offer aesthetically positive benefits that bring beauty into the city. The idea of Amenity can be traced back to the 18th century 'romanticism movement' which created an admiration for nature, and of the influence of 'Victorian gardens' in urban landscaping. It is also linked to the idea of the 'garden city movement', which provided an answer to urbanisation by supporting the creation of 'sustainable' cities with emphasis on amenity areas for the public. Amenity can be considered as the effort to derive an aesthetic and sensual enjoyment out of the experience of nature with landscape (Jamieson, 2001), and to maintain a viable balance in urban environments.

The call for amenity in the natural environment is associated with demands for conservation, natural function, and improved aesthetics. To create amenity landscapes is to find a way of creating projects that more closely resemble the natural environment, preserve biodiversity and at the same time beautiful so that people will value and protect them. Amenity landscaping is a call for producing living environments that people like and accept.

Amenity, as part of the SUDS three-ring model (see Figure 2-2) incorporates many ideas of landscaping such as the conceptual, cultural, ecological, social, psychological and aesthetic function (Rohde & Kendle, 1997; Taylor, 2002; Whiston Spirn in Johnson, 2002; Ward Thompson, 2002; Parsons & Daniel, 2002; Tress et al, 2001) while it is closely linked to biodiversity (Figure 4-7, Figure 5-1). To most people, enhanced amenity means an increase in recreational or sports facilities and the opportunity to use open green space around ponds or close to rivers as leisure areas. Professionals and the public associate amenity with wildlife benefits, with improvements to the aesthetics of the surrounding area, and with recreation and leisure.

Suggested improvements on Amenity

Participants in the surveys suggested improvements linked to the amenity open water schemes underlining the importance of amenity for the public.

The results of this work demonstrate the transformation of schemes into amenity and recreational features. Amenity appears to be increasingly important for local communities, a

finding that is in agreement with the current trend amongst planners who are encouraging 'new model villages' or 'sustainable communities' which incorporate traditional type housing developments located around a pond or close to other types of water features such as canals of high amenity value (Freedman, 2003).

The need for preservation of the amenity value of open water schemes, which is also closely linked to the biodiversity benefit, was realised and highly valued by the participants of the surveys. Amenity, within the research context, and in accordance with the concept of sustainability, encompasses societal and environmental benefits. The results agree with Johnson, in Thompson & Steiner (1997), who argues that schemes of high amenity value are seen by survey participants as a means of diminishing the loss of natural functions of new construction and making improvement to urban design.

7.2.3 Biodiversity Issues

The ecological and biodiversity benefits of stormwater management schemes are closely linked in people's minds to amenity and are highly appreciated by the public. The importance of biodiversity preservation or the introduction of wildlife and plant life species into open water systems were included among the major perceived advantages of stormwater management schemes.

Flora and fauna were considered by many participants in the surveys as educational resources for children, especially where the scheme is well established. This was an attitude clearly expressed in areas where the schemes were used by local residents for recreation and leisure, sports and family activities. This was particularly clear in the restoration of the Brent River and the landscaping of the surrounding park.

The biodiversity benefits of SUDS ponds and wetlands, and of river restoration schemes are also highly valued by the majority of professionals involved with these systems. However, according to the professionals, the public does not appreciate the biodiversity benefits of newly established schemes or even realise that there is any biodiversity benefit.

Suggested improvements on Biodiversity

The presence of wildlife and rich plant life in open water schemes, indicators of the sustenance and increase of biodiversity, can be of crucial value in ensuring a positive public opinion. One

of the main suggestions by the public and professionals alike to enhance or protect biodiversity related to the introduction of native species. Native vegetation has the benefit that it is easy to establish and maintenance requirements are reduced which assists in protecting biodiversity and appearance. At the same time, abundant vegetation attracts various species of wildlife already present in the area by providing extended natural habitats and shelter belts.

In areas rich in flora and fauna, participants were positive towards the schemes. Additionally, certain aquatic vegetation was considered to be able to provide a degree of self-cleansing of water via natural biodegradation procedures. This ability of open water systems to remove pollution from makes them sustainable and ecologically beneficial. The introduction of plant species, such as reed beds, is often used for biological water treatment (Kendle & Forbes, 1997). In addition, frequent cleansing of open water systems was perceived as a good way to preserve biodiversity and to combat the dangers associated with eutrophication (Figure 4-16, Figure 4-17, Figure 4-18, Figure 5-3, Figure 6-13, Figure 6-29.

The appreciation of the biodiversity element is clearly reflected in the public suggestion of introducing explanatory boards containing information on the flora and fauna in the open water scheme.

7.2.4 Landscape Preferences – Perceived advantages and disadvantages of stormwater management systems

Although landscape preferences are closely linked to personal preferences and cultural influences, a general attitude towards urban landscapes is that people from various cultures prefer natural environments to built environments or to environments where the human impact is very obvious (Ulrich, 1993). In general people tend to perceive "green" features as natural or as incorporating natural features even when this perception is not always realistic. The distinction between landscapes untouched by man and landscapes which have undergone human interventions in the past is not always very obvious in the eyes of the public, as for example in the case of Niagara Falls, and in the landscaping of national parks which, although they have been subject to numerous interventions, are still perceived by the majority of the public as natural features (Cronon, 1995).

The 'naturalness' of a system, as perceived by the public, is among the main perceived benefits/advantages. This means that the public more readily appreciate open water systems

when they are well-established in an area and when they resemble natural features; they welcome natural-looking stormwater management systems in their local community. This has als been identified by a series of other studies (Anderson & Meaton in Miller & de Roo, 2000; Johnston, 1990 in Kendle & Forbes, 1997; Strumse, 1994; Kaltenborn & Bjerke, 2002).

In addition to the advantage for everyday life of the natural appearance of ponds and river restoration schemes, such schemes are perceived to assist in re-establishing the relationship between urban citizens and nature which is critical for modern societies (Kellert & Wilson, 1993; Airaksinen, 1992). This attitude was also expressed during the focus groups in the current survey. The aesthetic function of green open spaces within cities and the association of the systems with leisure and recreation also underlines the conceptual (in establishing a link between urbanisation trends and nature), cultural, ecological, social, and psychological functions of these types of system. Other pieces of research on public preferences and on the multi-functionality of open urban green space, demonstrate that urban landscapes serve these functions and that the social and cultural value of open space is normally considered as the driving force for their creation (Tress et al., 2001).

Landscapes are often considered both to serve human needs and have high value to the ecosystem, an attitude which highly influences the preferences towards SUDS and river restoration schemes. Of course there is often a combination of reasons that encourages people to protect landscapes or influences their preference towards landscapes which appear to be natural (Kaltenborn & Bjerke, 2002). The main parameters influencing urban landscape preferences are: age (Balling and Falk, 1982; Lyons, 1983; Zube et al., 1983), educational level, and occupational interests (Yu, 1995). Regardless of the above and despite personal preference, there is a general trend towards schemes which appear to be natural (Apostolaki, 2003; Strumse, 1994). This preference can also be attributed to the popular public perception that anything natural is beneficial for the surrounding area and also for humans. After all, urban citizens seem to realise that failing to have access to nature in the urban environment has a direct effect on their psychological and physical health (Kaplan and Kaplan, 1989).

The perception surveys of SUD ponds around the UK and of the river restoration schemes in both the UK and Greece clearly demonstrate the preferences for landscapes that are aesthetically pleasing (Figure 4-8, Figure 4-12, Figure 6-26). People usually equate improving the aesthetics of a scheme with its natural appearance. The preference towards everything that looks natural has led urban citizens to seek aesthetically pleasing, pristine and easily accessible

places within cities. This has been identified in the literature by Johnson, in Thompson & Steiner, (1997) and Hough in Johnson, (2002) and during this research work.

Suggested improvements to open water landscapes

This preference towards open water schemes of high aesthetics was also reflected in the suggestions offered by the public. The surveys participants clearly expressed the attitude that landscaping which appears natural serves several purposes. It improves the appearance of the scheme, it makes it more easily accepted and if this is related to rich marginal vegetation it acts as safety barrier and helps preserve ecological stability (Figure 5-2, Figure 5-3). The preference towards amenity features in urban landscapes was also underlined. It was made very clear that people would prefer and make more use of the open water schemes if they included recreational and leisure features such as benches and picnic tables overlooking the open water together with children's playgrounds and walkways close to the open water scheme.

7.2.5 Safety of Open Water

Safety, and specifically the potential danger of children drowning, was the main perceived disadvantage of open water schemes. However, the degree of concern was site specific and highly dependent on site characteristics and the appearance of the open water. Safety was the main concern close to newly-established schemes, as for example at Halbeath Pond in Scotland and in ponds in the Midlands (safety concern: up to 70%). One reason is that at sites where there is limited or no marginal vegetation and steeper slopes, there actually is a potential danger. In addition, schemes with aesthetically unpleasant and untidy open water create the perception that they are also unsafe (Figure 4-4, Figure 4-12). On the other hand, in areas with well-established ponds, safety was rarely an issue, as for example at Coy Pond in Bournemouth where the participants in the survey expressed no safety concerns (Figure 4-11). Native vegetation in combination with wildlife makes a pond more natural, outweighing the potential danger.

Despite their safety concerns, the vast majority of the participants in the surveys still preferred to live in areas with open water, and they valued highly water within their residential area. This is in accordance with the views and findings of several other researchers (Garoeren & Rudoell, 1991; Appleton, 1975; Hjerpe & Krantz, 2000). When, during the research on stormwater management schemes in the UK and in Greece, participants were asked to compare different

safety risks within residential areas, respondents classified SUD ponds and open rivers as having the same dangers as natural ponds or rivers, whereas major road traffic schemes and landfill sites were deemed to be more unsafe (Figure 4-14, Figure 4-15, Figure 6-12, Figure 6-28).

In contrast, in flood prone areas, the risks of flooding are perceived to be much higher than the risks introduced by an open watercourse. Residents in flood prone areas associate safety risk with the occurrence of flooding and they felt highly disappointed when there were no provisions for flood prevention. It also worth referring to the feeling of social injustice created by most areas lacking flood protection being of lower to medium socio-economic status with old housing and infrastructure (UNESCO, 2003). Public consultation is not a common practice in such areas. Risk of flooding impacts on standards of living in the area as it imposes danger to life, poor hygiene and reduces well-being. Their houses tend to loose value and saleability and this prevents them from relocating into safer environments.

When it comes to professionals, almost half of the participants believed that SUDS ponds are safe when close to houses provided they are designed with safety in mind. In the minds of most professionals who participated in the UK, the public safety concern related to SUDS ponds and wetlands is a matter of perception and does not relate to an actual risk. This safety concern is more common amongst people who have never lived close to watercourses, are not used to contact with open water in their every day life and consequently they fear it. A high percentage of those participants (36%) stated that SUDS are safe, while all professionals questioned in Athens believed that there is no actual danger from the river running through the city. They believed that the safety of open watercourses is a matter of public perception and education, and is not of great concern to people who are used to living close to water bodies. Participants in Athens believed that in Greece people tend to live close to the coast and do not feel threatened by the presence of water within urban environments. On the contrary, they welcome every attempt to introduce natural looking water bodies within the heavily urbanised city of Athens. In addition the difference in perceptions of safety between the two countries or the different sites can be explained as a matter of different prioritisation. The danger of severe flooding at their homes concerned local residents more than the dangers imposed by the presence of an open river in the area.

In all areas, the professionals questioned believed that such safety concerns are often generated by examples of bad practice, especially where steep side slopes existed around SUDS ponds

and this has also been shown in other studies (Hjerpe & Krantz, 2000). Other factors which were found to influence attitudes towards open watercourses, were:

- The socio-economic background of the residents - the lower the socio-economic and educational background, the more negative the attitudes and the more difficult it is for people to accept new practices;
- Information provided to the public about the open watercourses - the better informed people are, the more positive are their attitudes even in matters of safety (also expressed by Beck, 1992);
- The safety concern for people and pets accidentally falling into the open watercourses.

Improvements suggested to increase Safety

On the basis of their safety concerns, many participants several suggestions were made by the public and professional participants, such as the introduction of natural aquatic vegetation barriers around open water schemes. These barriers are thought to serve a triple purpose: a) to form a safety barrier preventing young children from getting into water, b) to improve aesthetics, and c) to provide a self-cleansing ability to the system, not only improving the function and appearance of the systems but also eliminating risk from water born infections.

Members of the public most clearly identified the desirability of introducing warning signs close to the open water bodies, mainly signs warning of deep water. However, the introduction of warning signs could have a drawback that they underline the man made character of the pond. Professionals in general were not so keen on warning signs and definitely opposed the idea of fencing watercourses, an idea that was expressed by some members of the public.

However, the professionals suggested the introduction of rich marginal vegetation to reduce the danger of young children or elderly from accidentally falling into water. They also proposed using soft engineering practices, shallow side slopes, and shallow water that would in general make the public feel safer around constructed open watercourses.

7.2.6 Sustainability of the examined schemes and other Environmental friendly practices

The participants in this research programme, although not directly asked about the perceived sustainability of the stormwater management systems examined, were positive towards their

adoption. When compared to other 'sustainable' practices that are in general well perceived by the public, the stormwater management plans examined (SUD ponds and river restoration schemes) were characterised as important for incorporation into urban areas, and were often categorised as having similar benefits to well advertised and accepted practices such as recycling.

The perceived sustainability element in stormwater management schemes is seen as the fact that they are perceived as contributing to improving the everyday life of local residents. They do this by providing amenity, recreational and leisure opportunities which promote social equity via the flood prevention facility, by being economically viable and providing ecological and biodiversity benefits. All these perceived advantages of the systems, in combination with the fact that they are considered as equally beneficial to other environmentally friendly and sustainable practices, lend them a sustainability element.

In general, there is a public and professional preference towards the use of sustainable practices in river management and stormwater management. Sustainable management of natural sources such as rivers is gaining ground over traditional practices such as stream diversions which in most cases do not take into account environmental or societal factors. River restoration is considered to be one of the main environmental priorities for the community, especially in areas where severe flooding occurs, and in some cases it is rated equal to well perceived and widely advertised practices such as recycling (Figure 6-14, Figure 6-30). Above ground storage of water is becoming increasingly acceptable, especially in comparison with traditional underground solution, and is considered to be in line with the sustainability concept, as identified through the comparative study of river management practices.

7.2.7 Public participation and Education

Education and public participation in decision making and in planning are important issues in influencing public perception and acceptability of stormwater management schemes. All surveys of SUDS and river management undertaken as part of this research programme indicated that there is a gap in information available to the public. This information gap is especially related to the need for stormwater management practices, the purpose they serve, their efficiency, and the benefits offered. The lack of information was considered by many participants as one of the main factors generating negativity towards the systems examined. It

seems that information and aesthetics are major influences on the acceptability of new or innovative practices within residential areas (Rohde, & Kendle, 1997). Participants who were well informed, and especially those informed prior to project implementation in their area, expressed more positive attitudes. Although the tasks of raising public awareness and changing behaviour are hard but necessary (Rookwood in Blowers, 1993; O'Keefe and Shepard, 1999; Nowak et al., 1997 in Shepard, 2000), the surveys showed that there is a clear need for providing more information.

Public information is the means by which residents are made aware of the environmental and societal advantages of a new scheme, and in this way acceptability of new schemes is enhanced. There is a clear need to clarify concepts and remove concerns and myths related to newly introduced schemes. As a prerequisite of the Water Framework Directive, the provision of information to the public is necessary for the successful implementation of any water management plan, and is widely recommended (Rohde & Kendle, 1997). In all areas where residents were better informed, the overall perception of the schemes was much more positive than in areas where little information had been provided. In Scotland and in the Bournemouth area, where there was a lot of public information on stormwater management, people were more positive in accepting schemes. People had been informed through leaflets and public meetings, organised mainly by the community councils. These methods were also recommended by many participants in the surveys.

The importance of public consultation prior to construction was again identified as a means of increasing acceptability. In general, participants in all areas were most willing to express their ideas and concerns about the planned or completed schemes. They were happy to participate in the planning process since they are the ones who are asked to live with the new schemes. For example, in the Brent area, the majority of participants were satisfied not only with the improvements, but also with the fact that they had been consulted in advance about the river restoration scheme. Although some of them blamed the local council for poor financial management, they still were positive towards the scheme. On the contrary, where the public felt that their ideas and needs were largely ignored, people were very disappointed.

Special attention should also be paid to the issue of increasing social justice through consultation and public participation during the planning process. Social justice is often expressed by evaluating the good and the bad in an effort to try and identify the greatest benefit for all in the long run. In terms of urban planning, social justice is a matter of producing and

distributing services in a way that maximises total welfare or aggregates social utility. When referring to stormwater management systems, social justice focuses on the issue of improving living conditions for citizens of any socio-economic background. In an ideal society, social equity and justice are reached through the procedure that individuals, in this case urban citizens, reach a consensus on a social contract which also includes local authorities in an effort to provide equal access to resources and benefits (Liu, 2001).

A feeling of social injustice was often met during the application of this research programme, particularly in deprived areas. This feeling was often related to the absence of prior consultation in areas of lower socio-economic level. This often results in the construction of systems that are not well perceived and less widely accepted by urban citizens. It also has a direct effect on people's willingness to continue living in the area, while at the same time there is an interlinked drop in housing value which prevents relocation to other areas subsequently rendering their neighbourhood as an increasingly deprived pocket within the city. In contrast, in areas of high housing value and socio-economic background, citizens are often consulted prior to and during construction with resulting in positive outcomes for their area.

Suggested improvements on Public participation & Education Strategies

The provision of information to the public is the first step in promoting public participation in decision making and planning required by current legislation (WFD) and has been highlighted in this research programme. In this case, information is required on the purposes served by the pond or river restoration scheme, the advantages of the schemes in comparison to traditional drainage, and their function and performance.

The research has shown that a good way to educate people on the benefits of open stormwater management schemes is the introduction of educational boards close to the open water schemes. Such educational boards were well received and highly valued by the participants of the surveys, who suggested that information on the flora and fauna in the schemes should be included.

Public consultation prior to construction, and public participation during the planning process were recommended by participants in the surveys. In particular, participants in the comparative study believed that consultation would have positive results in increasing acceptability of above ground stormwater management systems. In the case of the River Brent in London, where there had been a public consultation exercise, the majority of the public approved of the park

developments and perceived them as features of high amenity value. The public in Brent was more than willing to participate, and the acceptability of the solution was high. One of the reasons behind the high acceptance of the plan in Brent was that the educational strategy undertaken in the area increased the confidence of the residents since their voices were heard. The opposite is true, and in Athens, participants thought that the public had been shut out of the decision making process and they made particular requests for consultation in future. The same suggestion was made in Glasgow by the residents heavily affected by flooding. They made several requests to the planning authorities to be considered for consultation about the selection and implementation of the stormwater management plan in their area.

Educational campaigns, addressed to householders and especially to young people and children are a good way of enhancing acceptability of new schemes and of supporting public participation. Public education on environmental matters is considered not only to enhance public knowledge and acceptability, but also to contribute to creating healthier communities and to promote equity amongst citizens.

7.3 BARRIERS TO USING OPEN WATER IN URBAN STORMWATER MANAGEMENT

Apart from the assessment of attitudes and perceptions and the formulation of recommendations for improving the examined stormwater management schemes, this research programme also attempted to identify the main barriers in adopting these schemes from suggestions proposed by the participants, and in particular by the professionals and experts.

The experts who participated in the surveys often have to overcome barriers in implementing open water schemes within urban environments, the principal barriers being related to design characteristics, function and performance, safety and landscaping of the schemes.

The main barrier to implementing open stormwater systems appeared to be the maintenance issue. In many situations it is debatable which authority should undertake maintenance responsibility for opened watercourses. This often delays or prevents maintenance and tidying up being undertaken. There is wide debate in the UK between water authorities, road authorities, city councils, and developers on this issue, with all parties trying to pass the responsibility onto others. The main reason for this is the cost of maintenance which, in

combination with the cost of construction, is the main barrier to the introduction of above ground stormwater management schemes.

Land take is also a major barrier for authorities and developers who give higher priority to the commercial exploitation of the available land over above ground stormwater management schemes or other green spaces.

A further barrier both in both countries was the lack of knowledge and training amongst the "so-called" experts in drainage design and landscaping of the surrounding areas. Professionals believe that the fear of any new and innovative system within residential areas increases with poorly conceived and constructed projects. This worry focuses on the fear that the new systems may not establish well, may eventually be shown to be inappropriate, raise public concerns, increase fear over safety and will be aesthetically unpleasant and unacceptable.

Public perception and acceptability, which are influenced by a number of parameters such as information provided, the socio-economic background of the public, the functionality and appearance of the schemes and the maintenance issue, are important barriers to above ground water collection systems. Factors that influence public acceptability include the lack of public education on relevant issues and the negativity which derives from examples of bad practice in matters of function, maintenance and appearance. Bad landscaping, which is frequent due to the high cost of landscape architecture, can also constitute a deterrent to open stormwater management.

7.4 SUMMARY OF PRINCIPAL OUTCOMES AND UNEXPECTED RESULTS

The major outcomes of the public perception surveys underlined the importance of four main factors affecting public perceptions of stormwater management practices:

- Aesthetics;
- Safety concerns over water existence in urban environments;
- Education on the schemes to affect attitudes towards water bodies and perceptions of risk;
- Enhancing public awareness as a means to increase public acceptability.

An unexpected outcome was the finding that, despite the safety concerns, people would still prefer to live close to water bodies if they felt they are well conceived, constructed and maintained. It was also interesting to identify differences in perceptions between the public and the professionals questioned, for example in matters of perception of amenity, biodiversity and safety. Professionals perceived public awareness and interest in amenity and biodiversity issues to be lower than it actually is. Members of the public are very concerned with safety issues especially when they are not informed about system function, the benefits gained from their use, and the actual safety of the system. This was an expected finding which has also been found in other studies (Hjerpe & Krantz, 2000; Irwin, 2001) and in the literature (Beck, 1992). The professionals strongly believe there is no actual risk and the relevant concern is only a matter of perception.

8 CONCLUSIONS

"...And now that you have gained wisdom and experience you must have realised what Ithacas do mean."

— Kavafis, 1911

This final chapter presents the conclusions derived from the analysis and interpretation of the research results, as well as the overall conclusions related to the nature of the work regarding the advancement of knowledge and applicability of the research.

8.1 MAJOR OUTCOMES

The different phases of the three years of field work on perceptions of stormwater management schemes have produced similar outcomes which are summarised in this section. Overall, the majority of the public were found to be more concerned with matters linked to their everyday life rather than global environmental issues. However, 92% of participants were able to link their everyday activities to potential pollution to the receiving water.

The amenity and biodiversity benefits of open water schemes which were well conceived and implemented were highly appreciated in all research areas. As a result, the aesthetics of new schemes were identified as being of major importance in enhancing public acceptability. A most important perceived advantage of open watercourses was that they help to re-establish the relationship between urban citizens and nature. Several respondents, members of the public and professionals, believed that the open watercourses have been successful in creating a natural feature within the urban environment and in re-uniting urban citizens with their lost links with nature. Natural landscaping and improvement of aesthetics also appear to become increasingly important for urban citizens and they are also perceived to give environmental and societal benefits.

However, attitudes differ according to site characteristics, and are strongly influenced by the aesthetics and the amenity benefits of the schemes. In areas with well-established schemes, the participants tended to be more positive and the perceived advantages outweighed the disadvantages.

The main concern about open water schemes seems to be the perceived safety risk but this is greatly influenced by the aesthetics of the schemes and how 'natural' they appear. It is also influenced by the level of public education on behaviour and how to avoid potential dangers close to water. The need for maintenance and tidying up of the scheme and its surroundings, unblocking of inlets and outlets, silt removal, and maintaining marginal vegetation, was stressed as being important issues. The absence of maintenance often results in an untidy and unattractive urban environment generating negativity towards the schemes and raising concerns over safety.

The need to incorporate flood prevention measures into the design of schemes was also clearly indicated and was prioritised over other recommendations in those areas facing serious flooding issues (Glasgow and Athens). Overall, the public in the two countries where the surveys were undertaken were in favour of sustainable river management practices and they perceived these practices to be beneficial for their area. This was a clear preference for open water solutions rather than traditional approaches to river management.

Public consultation prior to the construction of stormwater management projects, especially when they are large, and public participation in planning and implementation of newly built schemes is vital for their acceptability.

8.2 RECOMMENDATIONS AND BARRIERS TO THE USE OF SUSTAINABLE DESIGN

A series of recommendations are made on the basis of the perceptions assessed in this research programme and the suggestions made both by the members of the public and the professionals involved in stormwater management planning. General are made recommendations for open water schemes in residential areas, such as the schemes of interest for this research programme, and will have the result of improving scheme performance, appearance, efficiency and acceptability among local communities. The recommendations are grouped into three main categories which relate to the schemes' characteristics, to operation and maintenance issues, and to public education.

A summary of the main recommendations of the research and based on the public suggestions are presented in Table 8-1.

Table 8-1 Principal Recommendations

Schemes characteristics	Make the open water scheme as natural-looking as possible/ increase greenery Improve marginal vegetation for safety and amenity reasons Introduce more vegetation (native preferably) if the existing vegetation is limited Introduce wildlife and fish, or protect the wildlife species already inhabiting the pond or the river Make shore slopes of pond or river softer Introduce natural barriers as safety measures Introduce warning signs on water depth Introduce features that enhance amenity of open water schemes and provide leisure opportunities (benches, picnic tables, children playgrounds, walkways)
Operation & Maintenance	More frequent litter removal Clean inlets and outlets of the scheme to avoid blockages Maintain marginal vegetation
Education	Provide relevant information to householders Apply educational campaigns for members of the public. Introduce educational boards close to the open water stormwater management schemes Promote public consultation and involvement in planning

Note: For source material, see Figures 4-16, 4-17, 4-18, 5-2, 5-3, 6-13 and 6-29.

These recommendations can be used to inform planners and decision makers on how to improve open water schemes associated with stormwater management facilities and on how to make those schemes more readily acceptable within residential areas. The main question that arises, though, is related to why 'sustainable design' and 'sustainable approaches' are not always adopted in the planning and implementation of stormwater management schemes.

The main barriers to adopting sustainable design identified by the research include the gaps in regulation over the implementation of 'sustainable' stormwater management schemes and the adoption of their maintenance, the lack of expertise in applying, operating and maintaining new systems, and the absence of public participation at the design and implementation phases.

Answers to these barriers should be sought using a combination of approaches including new regulations to establish the framework for the design and the implementation of stormwater

management schemes, training of relevant professionals by experts, and public inclusion in the decision making processes.

8.3 ADVANCEMENT OF KNOWLEDGE

A central aim of this research programme was to increase the understanding of stormwater management installations from a social perspective. When implementing stormwater management plans and engineering options, the decision makers, planners and implementers of technologies do not often take into account the public perceptions and concerns of the public despite the fact that this is of crucial importance for social acceptability. This research has thoroughly examined and produced new understandings of the social impacts of stormwater management projects. The results are of assistance to professionals involved in stormwater management to understand the needs and expectations of urban citizens and to design socially acceptable stormwater management structures with sustainability and amenity in mind.

This work has been the first to attempt to provide a wide understanding of SUDS in the UK and to clearly identify the role of public participation in the planning process of stormwater management schemes. There is extensive coverage in the thesis of the social response to SUDS implementation in the UK, and establishment of a holistic view of the social impacts of such structures. The results of the work inform and create new knowledge areas for stakeholders/ professionals involved with SUDS in understanding how:

- The public perceive SUDS;
- To enhance the acceptability of SUD systems by incorporating suggestions made by the public into the design and implementation of new schemes.

The assessment of attitudes and public needs for specific engineering schemes is a basic step before establishing the ground rules of public participation and engagement into participatory planning. A thematic analysis of the issues was adopted in an effort to better understand the factors influencing the perception of stormwater management projects since they have to be taken into account when designing public participation programmes. The different themes and perceptions of nature and urban landscape design identified in the research and presented in Chapter 2 were not only used to inform the design of the questionnaires, but also to understand and interpret the results. In this way links were established between public preferences

expressed during the surveys and the general ideas outlined in Chapter 2. Knowledge was particularly extended in the following:

- Public preference towards natural-looking environments of high aesthetics and amenity value. This is in agreement with Anderson & Meaton in Miller & de Roo, 2000; Johnston, 1990 in Kendle & Forbes, 1997; Strumse, 1994; Kaltenborn & Bjerke, 2002;

- Public preference towards environments with water features are also expressed in Ebenezer Howard's 'Garden City Movement' (Howard, 1902), and the ideas of the move towards the 'Lost Eden' and Wilderness (Jamieson, 2001; Coates, 1998; Cronon, 1995);

- There was agreement between the opinions of the public in the surveys and several thinkers on the role of aesthetics in increasing acceptability of water bodies, and the conceptual, cultural and psychological importance of aesthetically pleasing water bodies in urban areas (Airaksinen, 1992; Parsons & Daniel, 2002; Garoeren & Rudoell, 1991);

- Agreement between respondents and experts/authors on the effect that information has in formulating attitudes related to the presence of water bodies in urban areas even when matters as important as safety are concerned.

- Agreement between respondents in areas where there was limited or non-existent public consultation, and authors who believe that public consultation promotes social equity and justice (Liu, 2001; Howe, 1990)

The work currently presented also contributed to the advancement of knowledge of the examination of the perceptions of stormwater management schemes which combine river management practices and retrofitting of SUDS. Recommendations have been made to enhance acceptance and promote the implementation of integrated approaches to stormwater management. The recommendations provided are expected to be valued and used as guidance to designers, planners and developers.

8.4 APPLICABILITY OF THE RESEARCH

Sustainable stormwater management is gaining ground over traditional drainage solutions. One of the main obstacles to using above ground sustainable practices of collecting and treating

runoff is the reluctance of the public to accept new ideas. Public perception can either have positive or negative effects in urban design, and is likely to increase the pressure towards the adoption of sustainable practices. As a result, it is very important to understand public trends and perceptions in order to enhance acceptability of new schemes. The results of this research programme can be seen as a way to understand perceptions related to stormwater management and to realise what types of construction will be more readily accepted by the public.

This research has application in urban planning and in particular in the design of environmentally friendly stormwater management practices. The results are of use to policy makers, planners, stormwater management designers, and other stakeholders active in the design of schemes in an effort to enhance the public acceptability of schemes. The recommendations and barriers to the implementation of stormwater management practices mainly refer to the appearance of schemes and to details in the surrounding area. There is limited reference to technical issues. The recommendations can be used as guidance for improving the aesthetic and recreational value of schemes and for providing ideas on functional landscaping, an aspect often ignored in urban planning.

The research has shown that education can influence attitudes even on sensitive issues such as safety and can be used by authorities and planners as a means of enhancing acceptability of new schemes. Consequently, the results of these surveys can be help develop information campaigns which should be undertaken prior to the implementation of a project. This information can be utilised not only for stormwater management design, but also for other environmentally friendly constructions where the level of public awareness may be an issue. The information campaigns should be aimed at assessing public perceptions, attitudes and needs in relation to the stormwater management project. They should be used widely in an effort to increase public awareness.

Finally, the results of the research have been presented in conferences and meeting and have been published in the form of papers (abstracts of all papers are attached as Appendix-IV) and technical reports. Two reports addressed to decision makers, designers, developers and researchers, are also a part of other projects on stormwater management:

- Apostolaki S., Jefferies C, Woods Ballard B.- HR Wallingford, Report SR 622, 2003,"An assessment of the Social Impacts of Sustainable Drainage in the UK", DTI PII

Project on 'Sustainable Urban Drainage: economic incentives, social impacts and ecological benefits', HR Wallingford[9].

- Apostolaki S., Jefferies C., Environment Agency & SNIFFER, SUDS01, 2005, "Social Impacts of stormwater management techniques including river management and SUDS". This publication also constitutes Environment Agency R&D Technical report P2-258[10].

8.5 LIMITATIONS OF THE RESEARCH

The research programme had four main limiting factors. The first limitation related to time restrictions in carrying out a second round of perception surveys in some of the case-study areas where additional developments were planned. A post-awareness survey following improvements to the schemes or after construction/ establishment of the new stormwater management projects would have provided interesting and important results.

The second limitation relates to a sampling drawback. Concerns over the safety of the researchers necessitated that door-to-door surveys be applied during daylight. This resulted in a large number of the respondents being women. Additional surveys were carried out during weekends in an attempt to address this male/ female balance.

The third limiting factor was time available for door-to-door surveys and the cost involved which imposed time restriction pressures at each location.

Finally, the perception survey in Athens was limited since only professionals/ stakeholders were surveyed and no members of the public. The Athens survey formed part of the comparative study on river management which made use of door-to-door surveying in the other locations. This meant that the survey methods in Athens could only produce strictly qualitative results, limiting the quantitative analysis. In addition, due to the perception by the authorities that a door-to-door survey in Athens would have given rise to public outcry, and in order to avoid any political implications, only a few members of the public were interviewed.

[9] http://www.hrwallingford.co.uk/publications/drainage.html#suds

[10] http://www.sniffer.org.uk

8.6 THE NEED FOR FUTURE RESEARCH

This research has focused on reviewing ideas on perceptions of nature and water by investigating all factors involved in open water stormwater management practices in urban areas. It has emphasised the social dimension of stormwater management via assessing, interpreting and evaluation public and professional perceptions of sustainable stormwater management projects.

The results demonstrate that certain issues and trends in environmental conservation, aesthetics, amenity, recreation, and public involvement, can influence perceptions and acceptability of new schemes. Provision of information aimed at raising public awareness can be considered as a means of enhancing acceptability of new construction.

For all these reasons, this research can be seen as the basis for future investigations into these issues at other locations within the UK and Greece as well as in other countries facing similar issues. Further research on the assessment of the impact of environmental education and campaigning in formulating attitudes has been identified as another potential area of future investigation, where the outcomes of the current work can be built upon.

Post-awareness surveys on the perceptions of water bodies in residential areas using similar methodological approaches could also be used to assess the potential changes in attitudes either after a scheme has been established in an area or after a programme of environmental campaigning.

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APPENDICES

APPENDIX I-A: SITE SELECTION

Scottish Sites

In **Dundee** the SUDS systems are predominantly swales, both in-garden and roadside. The first site was served by both in-gardens and in-grass verges (Appendix I-A Figure 1 and Appendix I-A Figure 2). The second area in Dundee was drained by swales within public ground only. At the third Dundee site, runoff was collected and disposed of via a traditional positive drainage system. The socio-economic status of all three areas was comparable (medium to upper), allowing contrasts to be drawn between public attitudes of SUDS and traditional drainage systems.

Appendix I-A Figure 1 West Grange House with swale in the garden

Appendix I-A Figure 2 West Grange roadside swale

The **DEX site in Dunfermline** is a large area of new development which features strategically planned SUDS including source control, site controls and regional features. It is widely recognised throughout the UK as representing an example of good practice for SUDS, and is one of the largest sites in Europe where runoff drainage is predominantly or exclusively achieved with SUDS. Dunfermline has a rainy climate typical of eastern Scotland, and SUDS

have proved very effective both in terms of water quality performance and managing water flows. The numerous developers active in the area are interested in house owners' opinions of SUDS. In this case, the three sites selected for surveying were areas served by large scale retention ponds.

Two of the areas at DEX were situated in newly constructed residential areas of medium socio-economic status (Linburn Pond and Pond 6), whilst the other (Halbeath Pond) is located in an old residential area of lower socio-economic background where most of the housing consists of sheltered accommodation (council houses). The area around Pond 6 is shown in Appendix I-A Figure 3.

Appendix I-A Figure 3 Aerial photograph of pond 6 in the DEX area

Lancashire Sites

Research in Lancashire was undertaken during March 2002. Two surveys were carried out, one in an area featuring a retention pond and another in area which included a wetland.

Saxon Way, Kirkby is a housing development of about 600 houses constructed by Maunders Westbury Ltd. This residential area is of medium socio-economic class. The SUDS construction is a permanent wetland located in public open space at the edge of the development. There is one inlet and one open outlet, discharging into an adjacent stream. The function of the wetland is to attenuate and treat the retained water. Vegetation on the shore of

the wetland is sparse (Appendix I-A Figure 4), and the water is very shallow. Although the wetland is not particularly aesthetically pleasing, it serves as an amenity feature for the community as it is used as a pet walking area. There have been no reports of public (environmental) complaints in the area.

Appendix I-A Figure 4 Saxon Way Wetland

Appendix I-A Figure 5 Saxon Way Wetland open outlet

The Saxon Way site was selected for assessment of public perception because the wetland has not prompted complaints from the public despite its appearance. Additionally, it is the only example of a functioning wetland in the area.

Lancaster Lane, in Clayton Le Woods, is a development of about 100 houses of upper socio-economic background, approximately 50% of which have direct access to a retention pond situated at the edge of a public open space. The pond is adjacent to public open space (Appendix I-A Figure 6). Reed bed vegetation that was originally in place has since died back, due to poor maintenance.

Appendix I-A Figure 6 Lancaster Lane Pond

The area is of medium to upper socio-economic background. Significant numbers of complaints regarding safety have arisen sporadically.

South Coast Sites

Three sites were selected for the assessment of public perception in the South Coast area. All sites were served by ponds. One of them was located in Worthing and the other two were in Bournemouth. The sites can be characterised as follows:

Brookfields Park at Worthing Road, Rustington (West Sussex) is located within a development of about 360 medium to high cost houses, where various developers are active. It features one retention pond (Appendix I-A Figure 7) and one detention basin (Appendix I-A Figure 8), which provide attenuation. Water enters the retention pond via a single inlet and discharges via two outlets, one of which connects to a local stream and the other to the detention basin. The retention pond, which is located in public open space close to the development, is situated very close to a playground and parallel to the motorway and the railway line. This pond has been poorly maintained; waste has occasionally blocked the outlet to the stream, and silt has been deposited at both outlets and at the inlet. The ecological design of the pond is poor, with both marginal vegetation and wildlife being absent. The shores are steep and slippery, and could be perceived as being a safety hazard for children and pets.

Appendix I-A Figure 7 Brookfields Park retention pond

Appendix I-A Figure 8 Brookfields Park detention pond

This site was included in the study because it was felt that public perception surveys would provide useful feedback about safety concerns. Additionally, the investigative techniques engaged could provide comparative data between perceptions of safety risks relating to the pond and other hazards found nearby, such as motorway traffic and the presence of a railway line. The pond is located in an area of medium to high socio-economic background, a fact that

could yield useful information on how public opinions can be influenced or formulated according to such characteristics.

Coy Pond, Bournemouth is an established (old) pond (see Appendix I-A Figure 9 and Appendix I-A Figure 10), which serves to attenuate water flows from a local stream, although it was not designed as a drainage pond as such. It works as a storage pond, collecting water from one stream and discharging it into another smaller watercourse. The pond is located in an area of high socio-economic status. Households have direct access to the retention pond, which comprises part of a well-established park. It acts as an amenity feature for the area, being ecologically rich with vegetation and various types of wildlife (e.g. ducks, coots).

Appendix I-A Figure 9 Coy Pond

Appendix I-A Figure 10 Shore vegetation in Coy Pond

The pond is viewed positively by the public. The site was thought to provide a basis for safety concerns comparisons, as it is located close to a railway bridge, and the social status of the respondents is the same as that of the Brookfield Park site.

Alder Pond, Bournemouth, is another mature pond located in an old residential area of medium socio-economic background (Appendix I-A Figure 11). The pond attenuates the water from the local stream (stream), and works as a storage pond. It is a well-established pond exhibiting wildlife and rich marginal vegetation.

Appendix I-A Figure 11 Alder Pond

In general, it is positively perceived by the local residents and it is frequently used as a pet walking area (exemplified by public support for the pond; plans to construct a new dual carriageway at the site were thwarted when local residents protested in order to conserve the pond). The results of public perception surveys from this site, and those from the area surrounding the Coy Pond, may provide information which can be used as the basis for socio-economic comparisons. Both ponds are located in Bournemouth and they are both old well-established ponds, while the socio-economic backgrounds of the residents differ.

Gloucestershire Sites

In Gloucestershire two sites were selected for the public perception survey, both served by ponds.

North Common is a new residential area of about 60 houses served by a SUDS pond. The pond is separated from the houses by a small road and it is often used as a playground area. It has two inlets and one outlet, discharging to an adjacent stream. See Appendix I-A Figure 12.

Appendix I-A Figure 12 North Common Pond

The pond has been completely colonised by reeds. Water levels in the pond occasionally drop significantly, exposing the muddy substrate in certain areas.

This residential area is classified as being of medium to upper socio-economic status.

Emerson's Green is a new residential area situated close to a park of high amenity value. Three connected retention ponds are located within the park (Appendix I-A Figure 13, Appendix I-A Figure 14, and Appendix I-A Figure 15). In all three ponds, water levels are rarely high and the marginal vegetation is not rich. However, as the ponds are situated within an open green space with trees, they are perceived as being mature. The results from houses facing the three ponds were analysed together as the ponds' characteristics and the residents' background were very similar and all three ponds can be viewed as being part of the same site. The following photographs were taken during the summer months when the water level is lower than usual.

Appendix I-A Figure 13 Emerson's Green (Pond 1)

Appendix I-A Figure 14 Emerson's Green (Pond 2)

Appendix I-A Figure 15 Emerson's Green (Pond 3)

APPENDIX I-B: QUESTIONNAIRE ON PUBLIC PERCEPTION OF SUDS

Site:
Respondents' Address:
Respondents' Sex: *Male* *Female*
Respondents' Age Category: *18-29* *30-44* *45-60* *60+*

1. Which is/are your major environmental concern/s? Please indicate in descending order from the most to the least important.

_____
_____

2. Which environment would you consider as more polluted?

_____
_____

3. Do you know where water entering road gullies or drains goes?

_____
_____

4. Which everyday activities do you feel may contribute to water pollution via drains?

_____
_____

5. Have you ever heard of the term Sustainable Urban Drainage Systems?

○ Yes

○ No*

** Go to question 10.*

6. Can you briefly outline what you think the term Sustainable Urban Drainage Systems means?

_____
_____

7. Do you know what these (SUDS) are used for?

_____
_____

8. Are you aware of any Sustainable Urban Drainage Systems in your local area?

○ Yes, if so please specify:

○ No

9. How did you become aware of Sustainable Urban Drainage Systems?

_____
_____

10. In your opinion, what are the advantages, if any, of this pond?

_____
_____

11. In your opinion, what are the disadvantages, if any, of this pond?

_____
_____

If Safety concerns are mentioned, Go to question 12. Otherwise Go to Q 16

12. What is/are your safety concern/concerns related to this pond?

_____
_____

13. How far away from the pond would you prefer your house to have been located?

_____
_____

14. Would this safety concern be so high as to put you off living close to the pond or you still prefer it despite of the risk?

○ Prefer to live close to the pond despite the safety concern

○ Would prefer the pond not to exist in the area

15. On a scale of 1-5 could you please indicate how you rate the safety risk involved with the following with 1 being very safe and 5 being very dangerous?

○ Heavy Road Traffic	1	2	3	4	5
○ Natural Pond	1	2	3	4	5
○ A river	1	2	3	4	5
○ Landfill Site	1	2	3	4	5
○ SUDS Pond	1	2	3	4	5

16. What improvements, if any, do you feel could be made to this pond?

_____
_____

17. Do you believe the economic value of the property increases, decreases, or remains the same in an area where SUDS are in place?

○ Increases, if so, by what percentage?:

○ Decrease, if so, by what percentage?:

○ Remains the same

18. Did the existence of the pond influence your opinion of property purchase in this particular area?

_____
_____

19. Which of the following environmental friendly practices do you believe is/are more beneficial for your city? Please outline the practices from the most beneficial to the least beneficial.

○ SUDS

○ Use of Renewable sources of energy generation

○ Refuse separation at source

○ Recycling

20. Would you like to get more information about this pond? (Not to be asked to those that have already made a request for further information)

○ Yes, if so, on what particular subject would you like to be informed, and how/when?:

○ No

21. Would you be willing to discuss further about this subject?

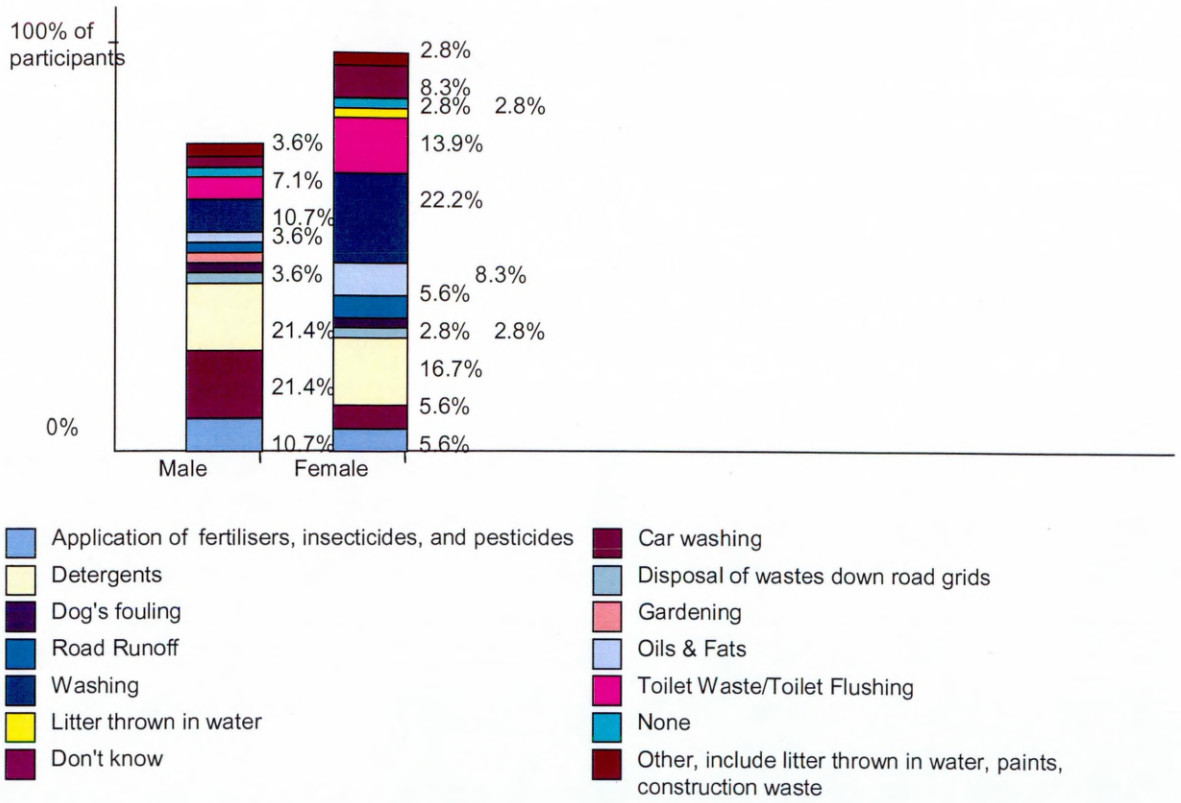
_____

_____

APPENDIX I-C: GENDER AND AGE-BASED RESULTS ON PUBLIC PERCEPTION OF SUDS IN THE UK

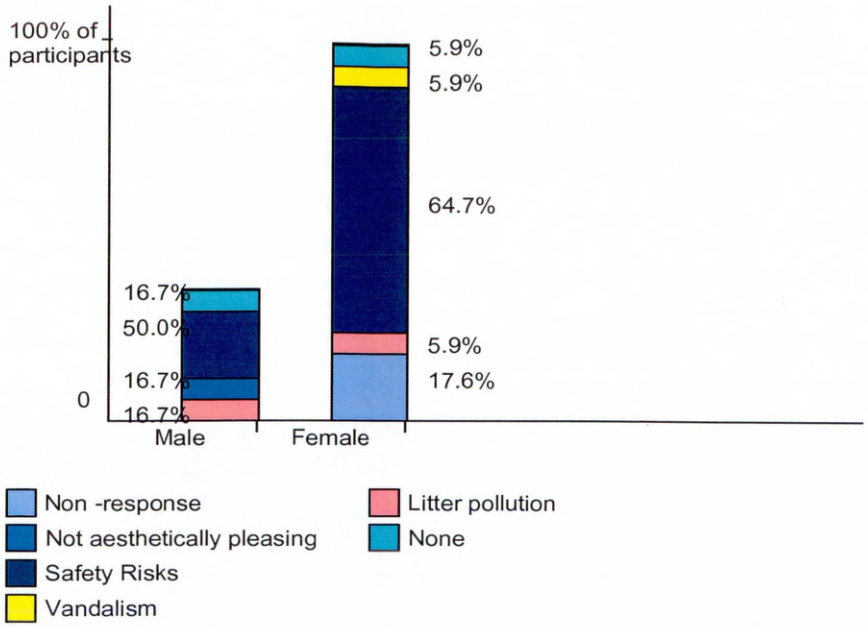
The participants in all surveys were selected randomly, however, the majority of them in all sites belonged to the 30-44 age group and were female. This can be explained by the fact that women of this age group spend a lot of time at home due to their housewife and children upbringing duties. Since the vast majority of participants belong to the same age group, age-based result analysis is not valid.

On the contrary, there were differences in attitudes based on the gender of the participants, in some of the questions. In general, the women participants were found to be less concerned over environmental issues than men. Additionally, different perceptions were expressed by men and women concerning their personal contribution to water pollution. Different activities or the same activities in different percentages were mentioned by respondents of the two genders and were based on the different household duties they undertake. For example, 22.2% of women mentioned washing but only 10.7% of men. On the other hand, 21.4% of men mentioned car Appendix I-C Figure 1.



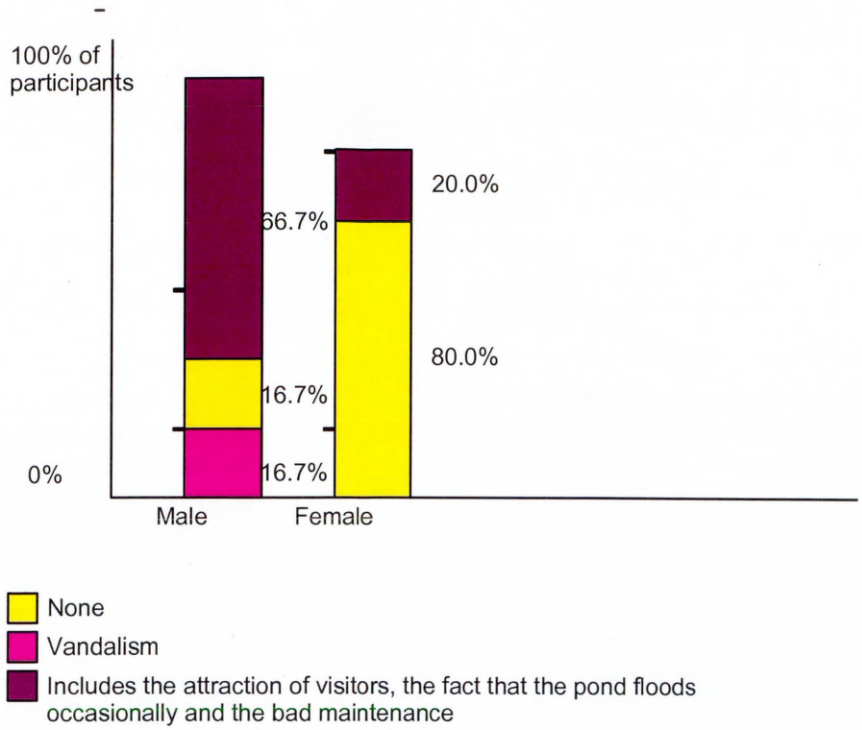
Appendix I-C Figure 1: Gender-based analysis of everyday activities, which contribute to watershed pollution (Worthing, South Coast)

Although there are no significant gender-based differences in the responses regarding the Pond's advantages, there is an increased concern over safety among women as indicated within the responses to the question about the disadvantages of the pond. When the same question was addressed to householders of an area close to a newly established pond, safety was mentioned by 50% of males and by approximately 65% of female participants.



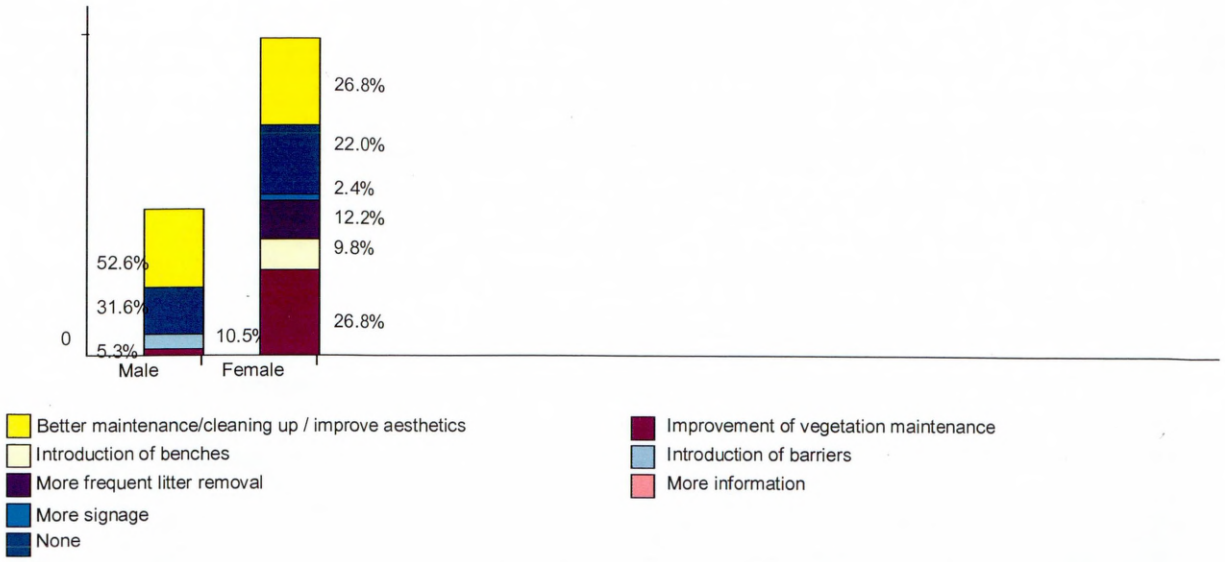
Appendix I-C Figure 2: Gender-based analysis of perceived disadvantages of a newly-established pond (Clayton Le Woods, Lancashire)

However, in an area where a well-established pond is in place, safety was not an issue at all and women seemed to be happier with the pond than men, with 80% of women stating that the pond has no disadvantages for the area, while the rest of them stated as disadvantages the fact that the pond floods over the road, the fact that it attracts visitors and increases traffic and the bad maintenance of the pond. Men stated the same disadvantages in higher percentages plus the fact that there is some vandalism in the pond. The percentage of men considering that the pond has no disadvantages was just 16.7%. The gender-based results are presented in Appendix I-C Figure 3.



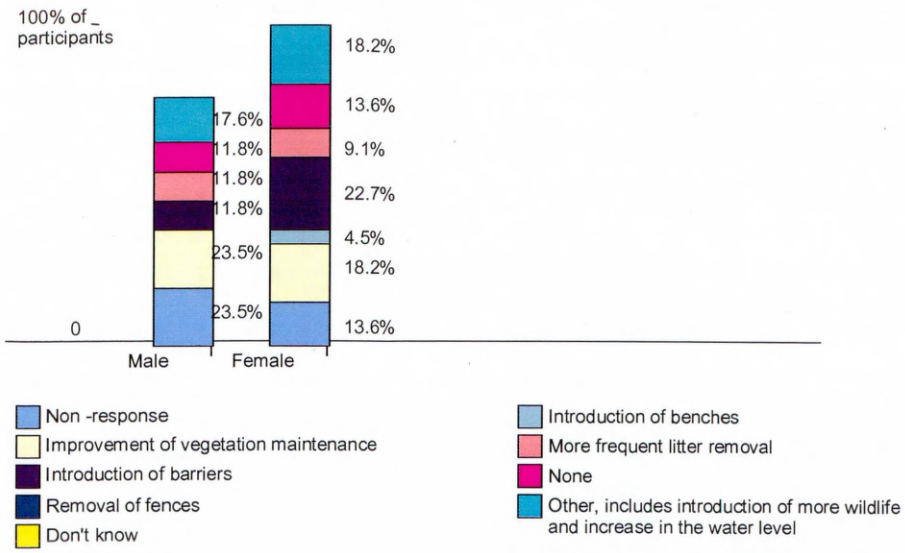
Appendix I-C Figure 3: Gender-based analysis of perceived disadvantages of a well-established pond (Coy Pond, Bournemouth)

Gender-based differences were also met with regard to the suggested improvements. In one area of a well-established pond, double the percentage of men than women requested better maintenance and cleaning up of the pond. However, it was only women participants who made a request for improvement of vegetation maintenance, more frequent litter removal, introduction of benches and signage around the pond, as indicated in Appendix I-C Figure 4.



Appendix I-C Figure 4: Suggested improvements in an area of a well-established pond (Emerson's Green, Gloucestershire)

As inferred by the gender-based differences regarding safety concerns there was also some gender-based differentiation in the suggested improvements, in areas of newly-established ponds where safety is a major issue. In one of these sites 22.7% of women participants recommended the introduction of barriers around the pond so as to make it safer, as opposed to only 11.8% of men who made the same request. In addition, 23.5% of the male respondents didn't outline any possible improvements as they thought that the pond could remain as it is while just 13.6% of women shared the same opinion. Introduction of benches around the pond was only mentioned by female participants.



Appendix I-C Figure 5: Gender-based analysis of suggested improvements in Kirkby, Lancashire

APPENDIX II-A: SEMI-STRUCTURED INTERVIEWS ADDRESSED TO PROFESSIONALS

Amenity value

1. Do you believe the stormwater management schemes of question are of high or low amenity value and why?
2. How do you understand the term Amenity within the concept of these schemes?
3. In your opinion how does the public appreciate the amenity value of these schemes?

Biodiversity

1. It is believed that open stormwater management schemes enhance biodiversity, and create new habitats. Do you agree with this statement?
2. In your opinion how does the public appreciate the biodiversity benefit of the schemes?

Safety concerns arising when SUDS are applied within residential areas

1. Do you consider those open water schemes safe enough to be located close to houses?
2. What measures do you believe could be taken to improve safety of the schemes?
3. Have you come across any public reports regarding safety concerns? If yes,:
   - What exactly was the concern on;
   - In which area;
   - What were the special characteristics of the site, if any?

Design characteristics

1. Do you believe differences in the design of open water schemes could influence public acceptability of the systems?
2. If yes, what amendments could be made in order to enhance public acceptability of the systems?

Effect on house pricing and saleability

1. Do you believe the existence of these schemes within a residential area could influence in any way the saleability of the houses and the house pricing?
2. Do you have any data regarding this issue? [Do you have any contacts where I could get this information from?]

Barriers to the application of such schemes

1. According to your opinion which are the main barriers in applying open stormwater management schemes within residential areas?

APPENDIX III-A: QUESTIONNAIRE OF THE COMPARATIVE STUDY

Site:

Respondents' Address:

Respondents' Sex: Male Female

Respondents' Age Category: 18-29 30-44 45-60 60+

1. Which is/are your major environmental concern/s?

_____
_____

2. Which everyday activities do you feel may contribute to water pollution via drains?

_____
_____

3. Do you know which is the receiving water body of this stream? (Where does the river's water end up)

_____
_____

4. On a scale of 1-5 how would you rate the stream's water quality, with 1 being very satisfactory and 5 being very bad?

1 2 3 4 5

5. What would you suggest should be done to improve water quality in the stream?

_____
_____

6. As far as you are aware has this area faced flooding problems in the past?

○ Yes*

○ No

If Yes, answer questions 7-10. Otherwise, Go to Q 11.

7. When did flooding last occur?

_____
_____

8. How often does the flooding occur?

_____

_____

9. How did the local authorities and the local residents deal with this problem?

_____
_____

10. As far as you are aware, have any measures been taken since then with respect to flooding?

○ No

○ Yes, if yes what sort of measures?

11. What do you think of the river restoration scheme and the landscaping of the surrounding park?

_____
_____

12. According to your opinion what could be the benefits/ advantages of this plan?

_____
_____

If Amenity is mentioned Go to Q 13. Otherwise Go to Q 14.

13. What does the term Amenity mean to you? (Or What do you mean by the term Amenity?)

_____
_____

14. How often do you use the park?

○ Daily

○ Several times per week

○ Weekly

○ Fortnightly

○ Monthly

○ Never

○ Other, please specify:

15. According to your opinion, what are the drawbacks / disadvantages of this plan?

_____
_____

If Safety is mentioned continue with Question 16 -19. Otherwise Go to Q 20.

16. What is/are your safety concerns related to this scheme?

_____
_____

17. How far from the stream/pond would you prefer your house to have been located?

_____
_____

18. Would this safety concern be so high as to put you off living close to the river or you still prefer it despite of the risk?

○ Prefer to live close to the river

○ Would prefer the house not to have access to the river

19. On a scale of 1-5 could you please indicate how you rate the safety risk involved with the following, with 1 being very safe and 5 being very dangerous?

○ Heavy Traffic on Main Road	1	2	3	4	5
○ Natural River	1	2	3	4	5
○ This Stream	1	2	3	4	5
○ Natural Pond	1	2	3	4	5
○ Landfill Site	1	2	3	4	5

20. Do you believe an alternative plan would have been more appropriate for the area?

_____
_____

21. Would you have to make any suggestions that would improve the river surroundings?

_____
_____

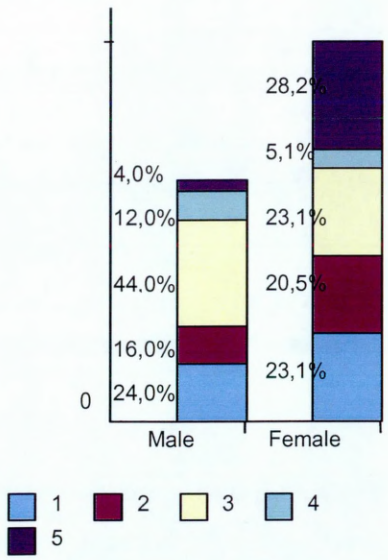
22. On a scale of 1-5 could you please indicate how you rate the following environmental friendly practices, with 1 being very beneficial for your city and 5 being the least beneficial?

○ The improvement of streams / Construction of better streams	1	2	3	4	5
○ Recycling	1	2	3	4	5
○ Use of renewable energy sources	1	2	3	4	5
○ Development/Improvement of Public Transport	1	2	3	4	5
○ Creation of a new park	1	2	3	4	5
○ Planting trees	1	2	3	4	5

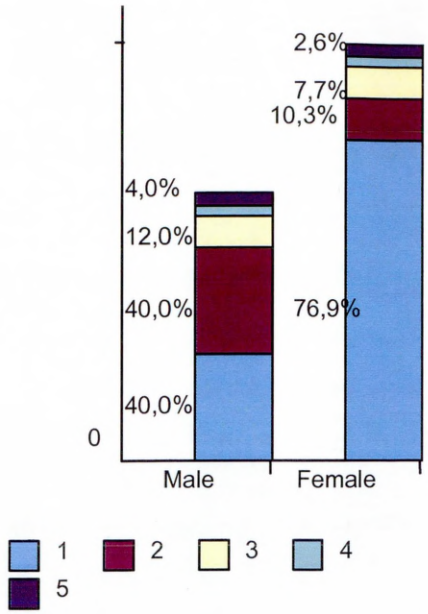
APPENDIX III-B: GENDER AND AGE-BASED RESULTS ON PUBLIC PERCEPTION OF RIVER MANAGEMENT

GLASGOW SURVEY

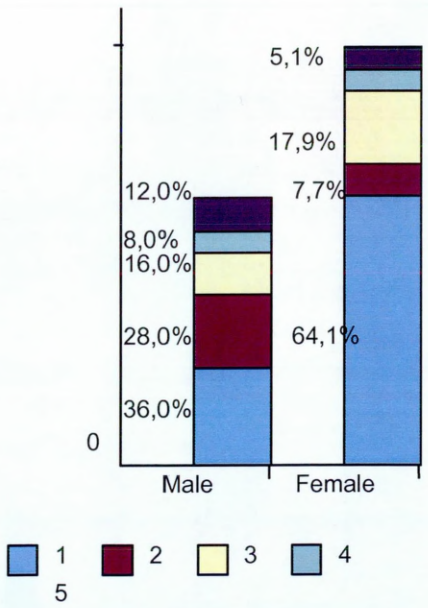
Overall, there were no big gender-based or age-based differences in the responses. In matters of general environmental issues and the suggested stormwater management plan for the area, the attitudes of the participants did not differ. However, a few differences were identified in the questions referring to the evaluation of environmentally friendly practices, with 1 being the rating for very beneficial and 5 for the least beneficial practice for the local area. Women seem to rate higher the benefits from river management, recycling, and the use of renewable energy sources than men do, as shown in the next three Figures. The evaluation of the improvement of public transport, the creation of a new park, and the planting of trees did not demonstrate important differences between members of different genders.



Appendix III-B Figure 1 Gender-based analysis of benefits from River management (1-very beneficial, 5-the least beneficial)



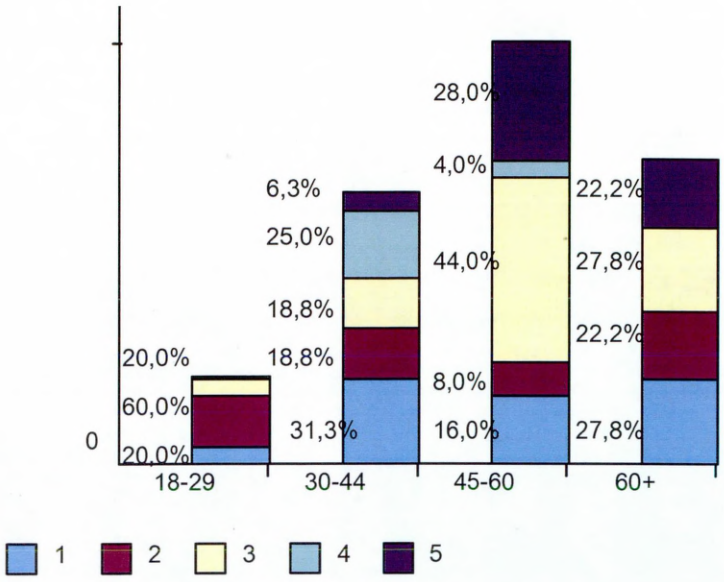
Appendix III-B Figure 2: Gender-based analysis of benefits from Recycling (1-very beneficial, 5-the least beneficial)



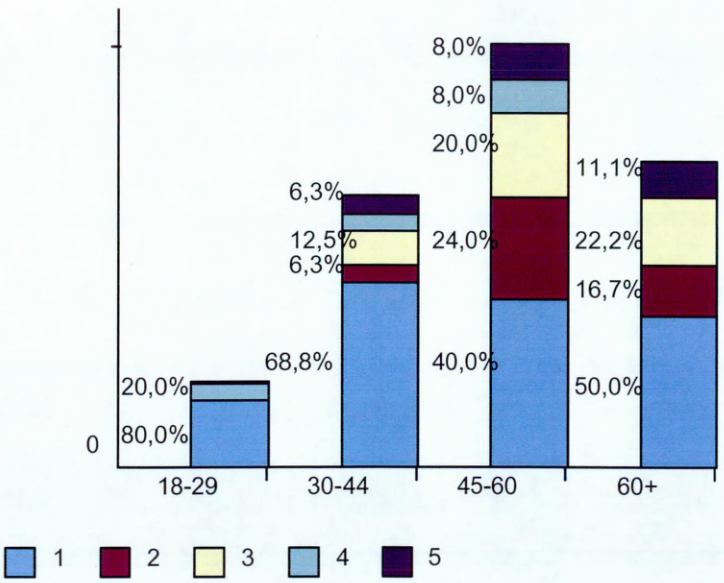
Appendix III-B Figure 3: Gender-based analysis of benefits from the Use of renewable energy sources (1-very beneficial, 5-the least beneficial

Different age groups also gave different ratings to some of the environmentally friendly practices, with 1 again being the rating for most beneficial and 5 the rating for the least beneficial practice located within residential areas. Overall, younger people rated all practices more positively than older people. Such a result was expected since younger people are usually

more educated on environmental issues, and tend to appreciate the benefits of environmental conservation, ideas that are nowadays present in school education. Examples of the age-based analysis on the benefits from river management schemes, and the use of renewable energy sources are presented in the two following graphs.



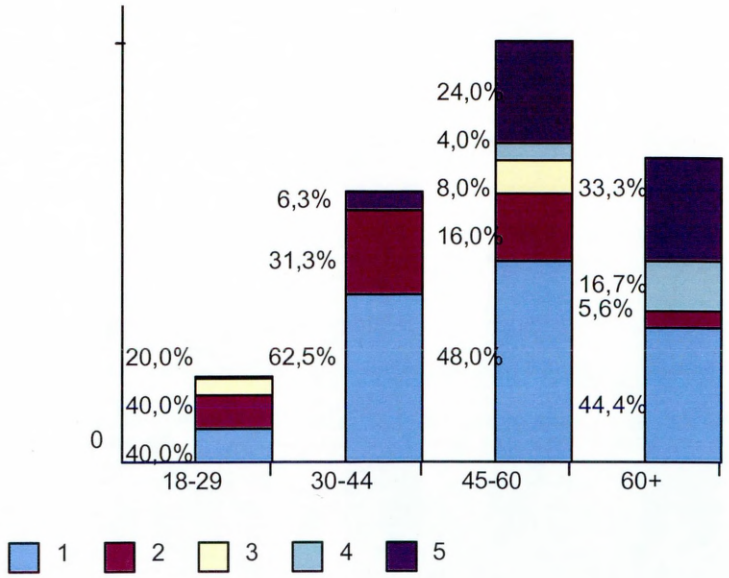
Appendix III-B Figure 4 Age-based analysis of benefits from River management (1-very beneficial, 5-the least beneficial)



Appendix III-B Figure 5: Age-based analysis of benefits from the Use of renewable energy sources (1-very beneficial, 5-the least beneficial)

Many people belonging to the age groups of 45-60 and 60+ didn't seem to appreciate the benefit of planting trees, they stated that trees which are not maintained regularly "pollute" the

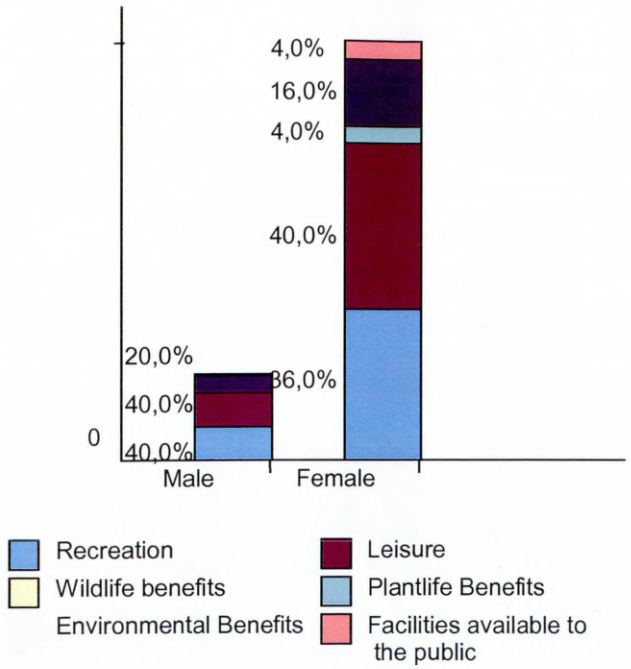
area with their leaves and they preferred a "tree-free" landscape. On the contrary younger people, belonging to the age groups of 18-29 and 30-44, have rated the planting of trees as beneficial for their local environment.



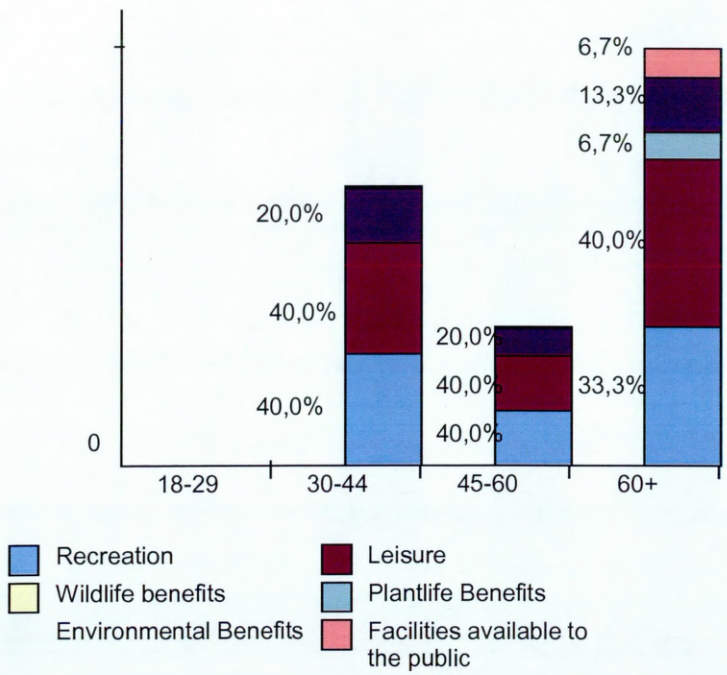
Appendix III-B Figure 6: Age-based analysis of benefits from Planting trees (1-very beneficial, 5-the least beneficial

LONDON SURVEY

In this area, there were no important gender-based or age-based differences in the responses. Differences were mainly found on the responses related to the meaning of "Amenity". Women and older people could indicate more qualities included in the term, while none of the respondents belonging to the 18-29 age group answered the question. These results are presented in the following Figures.



Appendix III-B Figure 7: Gender-based analysis of the term «Amenity»



Appendix III-B Figure 8: Age-based analysis of the term "Amenity"

APPENDIX III-C: SEMI-STRUCTURED INTERVIEWS ADDRESSED TO PROFESSIONALS IN ATHENS

Name	
Profession	
Affiliation with Kifisos project	
Date of interview	

1. On a scale of 1-5 how would you rate the stream's water quality, with 1 being very satisfactory and 5 being very bad?

1.a. What sort of pollutants are present?

2. As far as you are aware has the area faced flooding problems in the past?

2.a. If yes, can you please give details?

3. What do you think of the works at Kifisos?

3.a. What is your opinion on the works at Kifisos?

3.b. Do you agree with the river culverting scheme, and why?

3.c. Do you disagree, and why?

3.d Can you give the reasons behind the adoption of this practice?

4. Do you believe an alternative plan would have been more appropriate for the area? If yes, can you please provide details?

4.a. Could you make any suggestion for improvement of the current scheme?

5. Are you concerned over safety of open water courses i.e. an open river within residential areas?

5.a. Do you believe people are concerned over the risk from open water?

APPENDIX III-D: ATTITUDES ON KIFISOS

The current works at Kifisos received several criticisms through press and in publications by scientists, experts, and local residents. In general, the scientific community in Greece condemns the solution selected for Kifisos. A professor of the National Technical University of Athens (NTUA) stated in the newspaper "Eleftherotypia" on the 11/11/2002 while commenting on the recent floods in Athens: *"The works at Kifisos are constructed with data and guidelines of the '70s. The river and not the roadwork should have been prioritised, however, the study of the works does not reflect the seriousness of the situation"*. He mentioned that the river works have 50-year return period and are based on data collected 30 years ago and are considered inadequate for today. He underlined the fact that relevant constructions, such as dams or management of big rivers, are designed with 1:1000 return period, as happened in a much smaller scale river in the prefecture of Thessaly in Greece, called Pinios. And he continued by saying:

> *"Do not consider this safety level as extreme and over-safe. The flood incident that happens once in a millennium could happen tomorrow....The whole thing didn't happen the way it should have. There was no lab testing to identify the wrongdoings, the inability of the system to cope with the waterload. It is possible the covered part of Kifisos to transform to a two-storey river, one will be the covered and the other will be a surface river, which will overflow over a large area and could cost hundreds of human lives....A river without cover behaves much better hydraulic wise than another one which, although has the same width and depth, it is covered. The resistance developed between the water and the cement cover reduces the flow attenuation."*

He also mentioned that the example of Ilisos, which was covered years ago, should have been avoided for the larger river of Athens, which receives the largest workload in Attica (Tzanavara, 2002a).

Another professor of NTUA also referred to the floods of the 7th of July 2002 in the newspaper "Eleftherotypia". He mentioned that the current works at Kifisos have the capability to

attenuate water for only 3,5 hours. *"If the rainfall would have continued for another hour, very serious damages should have been expected"*. He also expressed the attitude that the solution adopted at Kifisos could improve the situation in a very small local scale but it will increase the flooding problem in other parts of Attica. *"It is obvious that for the appropriate flood protection of Athens a well designed masterplan is required, which will not only include construction works of high cost but also water management planning, and planning for dealing in emergency situations"* (Tzanavara, 2002b). In another article in the newspaper "To Vima" he stated for the floods of July 2002: *"That rainfall event was not an extreme one and shouldn't have caused problems of this scale in Kifisos...the heavy rainfall covered an area of about 100 square kilometres, which is the ¼ of Kifisos' catchment area"* And he continued on commenting on the undergoing works at Kifisos: *"... The reliability of a closed system of stormwater management is reduced in relation to open natural systems"*. (Mpitsika., 2002).

Another expert, professor of NTUA, referred to flood incidences at Kifisos underlining the lack of stormwater management masterplan for Athens. She stated: *"The urbanisation in Kifisos' catchment area is huge. The stormwater drainage system of Athens is inadequate and of poor maintenance. The streams have been covered by roads and houses. The flow attenuation of rainwater is not done in a natural way... usually during works in rivers we divert the water. This couldn't happen here. They were forced to work in the river, fact that created blockages in the river."* In the same article an older statement of the general secretary of the Association of Experts on Hydraulic Works, was mentioned, according to which he foretold that the works at Kifisos will result in serious flooding in the city. In 1997 he had stated that: *"the works at Kifisos and Attica do not protect the city. We are just transferring the waterloads from the upper parts to the delta of the rivers, where the condition is generally worse"* (Linardou, 2002).

A different suggestion on how to deal with the stormwater management of Athens was mentioned in the newspaper "Eleftherotypia" on the 09/09/2002. This suggestion was made by a hydrogeologist of the Institute of Geological and Mineral Research (an institute which numbers 270 scientists, 85 of which being PhD holders), and it was rejected by the Ministry of Environment Physical Planning and Public Works. Apart from suggesting opening of the banks of Kifisos he also suggested to convey the water from Scaramagka stream and from the upper part of Kifisos to a new stream of 1,5 km length that should be constructed at the north west side of Athens (Votsis, 2002).

TEE (the Technical Chamber of Greece) also contemned the management of Kifisos in its publications. In the TEE magazine, Volume 2226, it was stated that the flooding at Kifisos occurred due to the inappropriate and unscientific measures adopted at the river. Therefore, the engineers working at the worksite shouldn't be accused for the flooding as they are working with decency and professionalism in a type of construction, which shouldn't have been chosen in the first place. In the same publication the lack of adequate stormwater planning for Athens was also underlined (TEE, 2002a). In another TEE publication, the works at Kifisos were characterised as fragmentary and harmful. The fact that the original suggestions have not been followed was also criticised in this publication. The original suggestions included: cleaning of the river and the drainage, reconsideration of the covering of parts of Kifisos, protection of the existing rivers and streams in Athens, restoration of the rivers' surrounding areas, and surface conveyance of rainwater especially in coastal areas (TEE, 2002b).

Residents of the areas affected either by flooding or by the works at Kifisos, have strong opinions on the practice selected for the management of the river. Residents of the suburbs located at the southern part of the river, which they had been severely affected by the past flooding events, formed a community engagement group against the works at Kifisos. To demonstrate their desperation about what happens at the river, they named the activation group "Kifi-SOS". This group consists of about 350 householders. The vast majority of the residents share the same attitudes, although they may not regularly participate in the public meetings. The group Kifi-SOS has repeatedly presented the residents' attitudes in the local and national press as well as to the authorities and experts. They also sent relevant reports to the Council of State and to the European Commission without thought their thoughts to be seriously taken into consideration. The report sent to the European Commission is included as Appendix III-E.

The public, as seen in their reports, oppose the changes at Kifisos and they believe this plan will cause a series of problems:

- The plan doesn't provide proper stormwater management of the area, which is expected to suffer in the future from even worse flooding, especially in cases of blockages in the enclosed part of the river;
- Noise pollution; the noise from the motorway is expected to be over 80d(A) at the house facades, while the maximum acceptable level is set by law to 70d(A);

- Air pollution; the concentration of pollutants from car exhausts are expected to raise dramatically;
- Light pollution from the passing vehicles;
- Deterioration of the aesthetics of the area;
- Changes in the microclimate of the area;
- Danger for hygiene; insects and odour are expected to increase in the enclosed parts of the river, which will not be properly aerated.
- The local community suggestions for the area are:
- To separate the stormwater management plan from the roadworks;
- To enlarge the river and keep it open;
- To restore the river surroundings;
- To construct the motorway either somewhere else or at the sides of the river by expropriating properties as necessary.

Additionally, the residents of the area strongly believe that it is due to their socio-economic background that they have been so hugely ignored, fact that raises a big issue of social injustice. As the area is of medium to lower socio-economic status, the public is not usually consulted in big decisions. The authorities, according to the local residents, behave as if they are not concerned about the wellbeing of "poorer" areas, and they impose their decisions without taking into account the fact that the residents' economic status doesn't allow them to relocate. (Aloniatis, 2002).

The public criticism of the works has also been presented in the press. In several articles there was reference to the transformation of the river to a motorway, fact that it was "proudly" advertised by the Ministry of Environment and Public Works. The drawbacks of the enclosure of the river and the construction of the motorway over it have also been widely condemned by press (Terzis, 2004) (Ntanou, 2004).

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Tzanavara H., 2002b, *"O Kifisos antexei mono 3,5 ores"* – "Kifisos can cope only for 3,5 hours", Eleftherotypia, 08/11/2002

Mpitsika P., 2002, *"O Kifisos tha ksanapniksei tous geitones tou"* – "Kifisos' neighbours will again drown by the river", To Vima, 14/07/2002

Linardou G., 2002, *"Sto idio ergo theates" – "Spectators to the same play"*, Kyriakatiki Eftherotypia, 08/09/2002

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Terzis G., 2004, *"Mia ethniki ekso apo to parathiro tous"* – "A motorway in front of their window", Kathimerini, 18/01/2004

Ntanou M., 2004, *"O efialtis tis Ethnikis Odou"* – "The nightmare of the motorway", Kathimerini, 22/02/2004

APPENDIX III-E: PUBLIC REPORT TO THE EUROPEAN COMMITTEE WITH REGARD TO THE KIFISOS RIVER

To the

European Committee / Commission

Denunciation for violation of environmental Community Law

Remarks on the road construction works at Kifisos.

In the capacity of residents of Moschato and N.Faliro we recourse to the empowered Complaints Board of the European Community to denounce the Hellenic Ministry for the Environment Physical Planning and Public Works for the degradation of the quality of living and of the environment that will result from the construction of a highway alongside and above the river Kifisos, starting from Pireos Street and ending at the river's estuary.

We also stress the fact that serious breach of regulations concerning the protection of environment has taken place. We request that the European Community suspend the funding of the construction project in view of its grave impact on the environment combined with the endangering of our health and the breach of basic principles for the environmental protection.

Specifically:

The final planning of the joining of the road to the rest of the circulatory system only took place at the end of the year 2000 (Attachment 1), when all other technical studies had already been completed. How has it been possible for the traffic load to be evaluated when the road connection and the needs of traffic flow lie undetermined? It is also a fact that there had been no final basic technical data available during the elaboration of the Environmental Impact Assessment for the road.

The studies by MPE (Register.No. 22589/3-7-95) approved by the Hellenic Ministry for the Environment Physical Planning and Public Works (Register No. 42941/5-3-96) are the only

ones to have conformed to the procedures provided by the 1650/86 law (public domain notification, statement of expert opinion of the Prefecture of Piraeus – which was negative –). These studies proposed a four-lane two-way carriageway (two lanes for each direction) and support provided by a row of pylons alongside and at the centre of the riverbed. They also proposed a larger distance from the buildings' facades since the carriageway would be narrower than the one currently adopted. The currently selected project differs as far as environmental and technical parameters are concerned: Firstly, three lanes per direction will be provided, resulting in increased traffic load. Secondly, three rows of pylons will be constructed (one at the centre of the riverbed and two alongside), which denotes the larger volume of the construction, the increase in width and the decrease of the distance from the riverside apartment buildings. It is quite clear that the environmental issues arising from this project are far from being identical with those studied in the first Environmental Impact Assessments of 1995 and 1996. In an attempt to cover the discrepancies and violations, the following two documents were elaborated: a) Environmental approbation by the Hellenic Ministry for the Environment Physical Planning and Public Works (Register No. 63710/12-3-99) and b) Preliminary study against noise pollution (Register No. 67011/25-5-99). These documents are have not followed legal procedures i.e. the public has not been notified and the Prefectures of Piraeus and Athens have not been asked for a statement of expert opinion. The fact that these studies are totally unknown not only to the residents of the areas where the construction will take place but also to the Prefectural Administration of Piraeus and Athens proves the veracity of our claims. The Hellenic Ministry for the Environment Physical Planning and Public Works has issued the 107924/30-5-2000 modification decree (Attachment.2) whereby the substantial changes of the technical characteristics and the subsequent alterations of the environmental impact are countered by Paragraph 8 of the rationale: "The fact that the proposed modification of the project does not alter substantially the assessment of environmental effects on the area". It is quite evident that the argument is insufficient. The modified project simply does not have a legal Environmental Impact Assessment.

The modified construction project will cause the degradation of the environment and quality of living as well as harm to our health. For the buildings at 10 m distance from the road, the noise pollution levels L10(18h) at their facades have been evaluated by the Hellenic Ministry for the Environment Physical Planning and Public Works to be higher than 80 db, when the maximum admissible limit is set by law at 70 db (Attachment 3). The local climate will submit drastic

alterations due to the voluminous and ill matching concrete and asphalt construction that will cause a rise in temperature, especially during the summer months. The river Kifisos, overshadowed by the new avenue, is becoming an open, sunless gutter and the problems of odours and insects shall be more prominent than ever. The dramatic atmospheric pollution can be easily foreseen.

For all the above reasons and also for violation of the Council Directives 84/360/EEC of 28/6/1984 and 85/337/EEC of 27/6/1985, we recourse to the European Union and request the suspension of the funding of the project and the intervention of the empowered Control Board of the EEC to cancel the construction.

Environmental contamination issues

1. Noise pollution exceeding legal limits.
2. Chemical pollution.
3. Visual impact and degradation of landscape.
4. Aggravation of the odour problem.
5. Environmental contamination.

APPENDIX IV: ABSTRACTS OF PAPERS PRESENTED IN INTERNATIONAL CONFERENCES

Paper presented at the First National Conference on SUDS held at Coventry University on 18-19 June 2001 on *"Assessing The Public Perception Of SUDS At Two Locations In Eastern Scotland"*

S. Apostolaki, C. Jefferies, N. Souter

Urban Water Technology Centre, University of Abertay Dundee, Bell Street, Dundee, DD1 1HG

Any new and innovative technologies applied in housing developments, besides being economically and environmentally acceptable also have to be accepted by the public. Public perception of Sustainable Urban Drainage Systems (SUDS) although important, has not been widely assessed. A study was undertaken to investigate the public perception of two types of SUDS, namely swales and retention ponds, in two Scottish towns, Dundee and Dunfermline. The study aimed to assess the perception of SUDS in the context of environmental issues, of the perceived advantages and disadvantages of the systems, and the adequacy of the information provided.

Public opinion was assessed through the application of three separate but closely linked questionnaires applied at selected sites served by SUDS.

Paper presented at the Fifth Symposium of the International Urban Planning and Environmental Association, Chris Church, Oxford, 23-26 September 2002 on the *"Social Acceptability of Sustainable Urban Drainage Systems"*

S. Apostolaki*, C. Jefferies*, M. Smith* & B. Woods-Ballard**

*University of Abertay Dundee,

**HR Wallingford Ltd

The term Sustainable Urban Drainage Systems (SUDS) refers to drainage constructions which comply with the sustainability criteria. They serve multiple purposes such as flow attenuation, flood prevention; they provide recreational facilities, biodiversity and stormwater management benefits, while at the same time they are cost and energy efficient.

SUD systems have become increasingly popular in a number of countries including the UK. In Scotland, specifically, SUDS must be considered on all new developments. Public acceptability of SUDS can be a deterrent or a motive for householders in buying property in an area where SUDS are in place, and consequently, is of great interest for developers and engineers involved with the construction of SUDS. This paper presents the results of a study of the social impacts of these schemes within urban environments.

Paper presented at the First International Conference on "Sustainable Development and Management of the Subsurface", Utrecht, Netherlands, 5-7 November 2003 on the *"Perception And Social Acceptability of Sustainable Urban Drainage Systems"*

S. Apostolaki[1], C. Jefferies[1], M. Smith[1], Chatfield P[2].

[1]University of Abertay Dundee

[2]Environment Agency of England & Wales

The term Sustainable Urban Drainage Systems (SUDS), refers to subsurface and above surface drainage constructions which are considered to be sustainable, and are aimed at:

- Introducing treatment for runoff that is cost and energy efficient;
- Providing flow attenuation and protection from flooding;
- Improving the amenity value of the area of application;
- Introducing or enhancing benefits of habitat biodiversity to stormwater management techniques.

Public perception of SUDS can be a deterrent or alternatively a motive for developers using SUDS in their new sites, as it can influence householders' property purchasing decisions within the development. As a result, interest was initially expressed by developers active in Scotland for the perception of SUDS to be investigated. A first survey was carried out in November & December 2000 in Scotland. Further interest was expressed by consultants and the Environment Agency of England and Wales as well as by SEPA (Scottish Environment Protection Agency). Surveys were undertaken in spring 2002 aimed at assessing the perception of the public and their understanding of SUDS in different locations within the UK, to develop an understanding of the acceptability of SUD systems.

To obtain a more holistic view of the perception of SUDS, professional opinions on SUDS have also been investigated. The survey work was based on a series of interviews and focus groups with developers, planners, design engineers, academics, landscape architects, environment protection officers, water authorities, and local authorities. This paper presents the results of this survey work.

Paper presented at the 10th International Conference on Urban Drainage, Copenhagen/Denmark, 21-26 August 2005 on *"The Social Impacts Of Stormwater Management Techniques"*, included in the Conference Proceedings and in the:

Water Practice & Technology, Volume 1, issue 1, August 2006, Urban Drainage 10: Publication of Selected Proceedings from the 10th International Conference on Urban Drainage, Copenhagen/Denmark, 21-26 August 2005.

Apostolaki S.[1], Jefferies C.[1] and Wild T.[2]

[1] Urban Water Technology Centre

[2]Scotland and Northern Ireland Forum for Environmental Research (SNIFFER), Edinburgh Greenside House, 25 Greenside Place, Edinburgh EH1 3AA

This paper presents research results on the social impacts of stormwater management techniques applied within urban environments. The main aim of the study was to compare public and professional attitudes of stormwater management practices such as Sustainable Urban Drainage Systems (SUDS) and river management techniques.

It is clear that any new and innovative technology used in housing areas, besides being economically and environmentally acceptable, must also be accepted by the residents. There has been considerable interest in the assessment of the public perception of SUDS in the UK by consultants, developers, the Environment Agency of England and Wales as well as by the Scottish Environment Protection Agency (SEPA). This research was undertaken to inform such interest and also to obtain a more holistic view of the perception by professionals of SUDS. A comparative study of the perceptions of river management in three densely populated European cities facing similar storm water management problems was carried out. The selected cities were Glasgow in Scotland – U. K., west London area in England - UK, and Athens – Greece. All sites are located within flood-prone suburban areas, and different river management techniques have been proposed or adopted.